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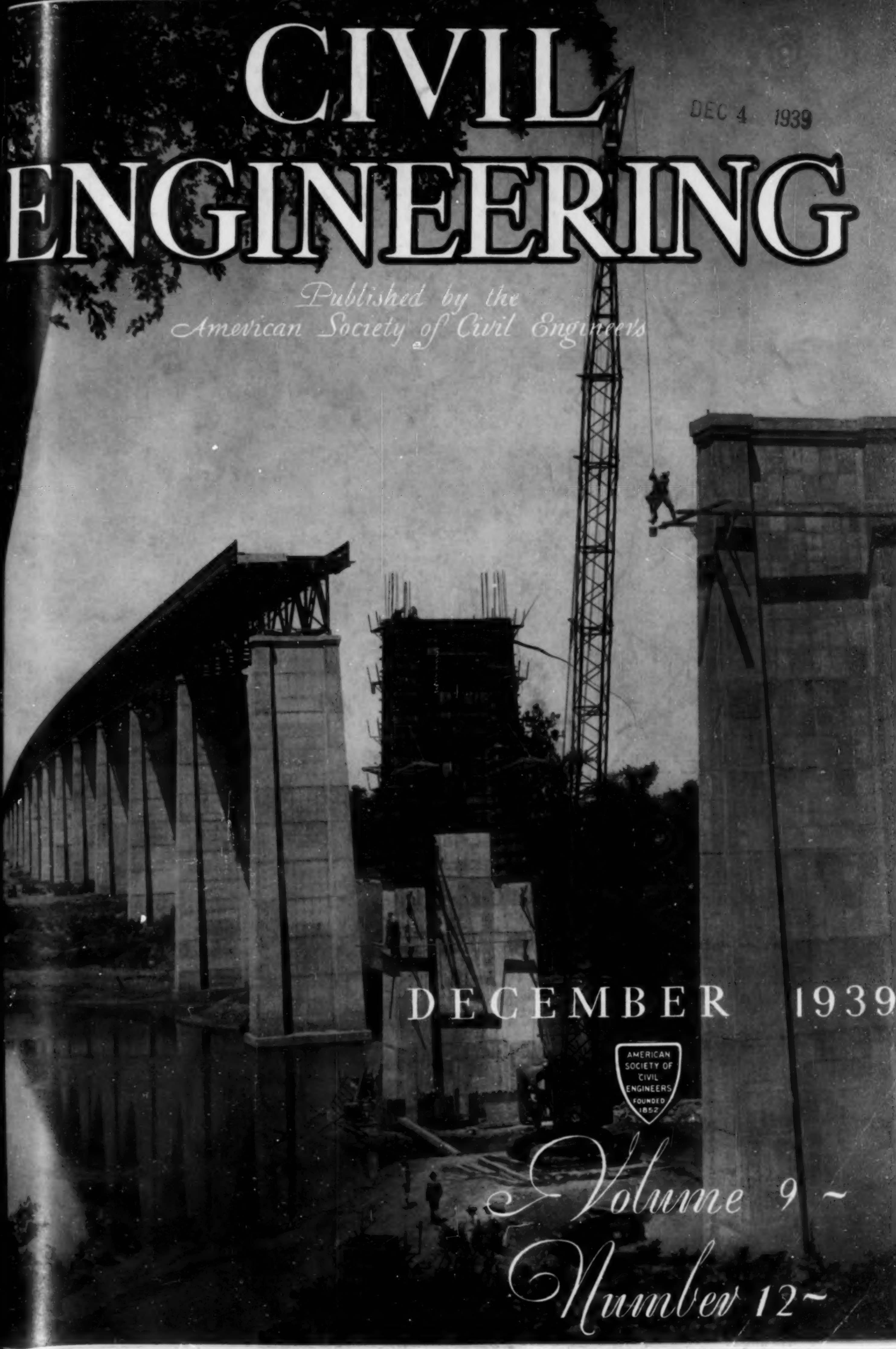

DECEMBER 1939

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Volume 9 ~ Number 12 ~

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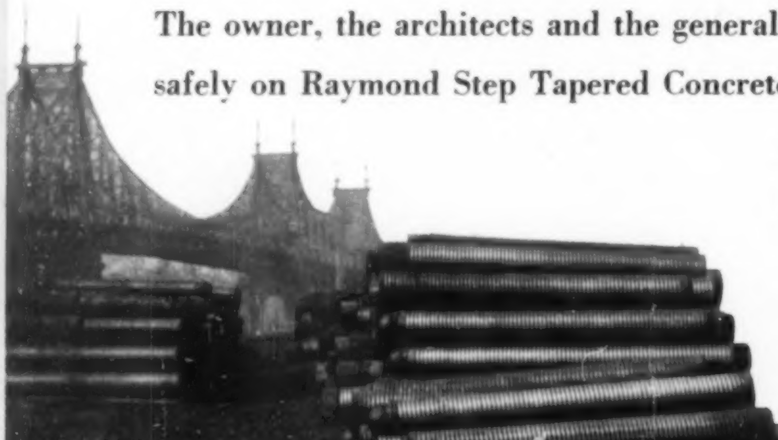

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Among Our Writers

THADDEUS MERRIMAN, who died on September 26, 1939, was consulting engineer for the New York City Board of Water Supply and had previously been its chief engineer. In recognition of his work on the Delaware water supply the large dam now building at Lackawack, N.Y., has just been designated the Merriman Dam.

CHARLES E. ANDREW (Univ. of Ill.) had had 13 years of miscellaneous engineering experience when he became bridge engineer for the state of Washington in 1921. In 1927 he went to work for the state of California in the same capacity, and beginning in 1932 was in charge of design and construction on the San Francisco–Oakland Bay Bridge.

JEAN P. CARRIERE has been with the Department of Public Works, Canada since 1928—three years in the drafting room in Ottawa; eight years at Rimouski, Que., where he became assistant engineer in 1936; and one in his present assignment at London, Ont. Previously he was on engineering work for three years in Hull, Que.

W. H. KIRKBRIDE (Leland Stanford, Jr., Univ., 1895) has been with the Southern Pacific Company Pacific Lines since 1902, since 1932 as chief engineer in charge of construction and maintenance. He is a past director of the A.R.E.A., a past-president of the San Francisco Section of the Society, and vice-president of the Seismological Society of America.

L. I. HEWES (Dartmouth, B.Sc., and Yale, Ph.D.) began his professional career with the Massachusetts Highway Commission in 1897. From 1901 to 1910 he taught successively at Rhode Island State College, Sheffield Scientific School, and Whitman College. Since 1911 he has been with the Bureau of Public Roads.

SIR CLEMENT D. M. HINDLEY was with the East Indian Railway from 1897 to 1921, and was chief commissioner of railways, Railway Board, India, 1922–1928. From 1929 to 1936 he served as chairman of the Steel Structures Research Committee. He has also been a member of numerous other scientific boards and committees, and is vice-president of the Institution of Civil Engineers.

G. E. ARNOLD (Colo. State College, 1926) was in Honduras with the United Fruit Company from 1926 to 1928, when he became chief engineer of the Western Well Drilling Company at San José, Calif. His present position dates from 1931. In 1938 he received the George W. Fuller award of the American Water Works Association.

VICTOR H. COCHRANE (Univ. of Ark.) has been in consulting practice in Tulsa, Okla., since 1922, engaged chiefly on bridges, viaducts, and hydraulic structures. In a number of papers and discussions he has contributed to the development of the design of arch bridges and multiple-arch dams.

IRA D. S. KELLY was for two years a structural engineer with the N.L.M.A. and its subsidiary, the Timber Engineering Company of Washington, D.C., and was in charge of their joint Chicago office. Previous experience included 11 years on highway and bridge design and construction, and he is at present a senior engineer with the Kansas State Highway Commission.

JOHN D. WATSON was with the Alabama Power Company in 1929 and 1930, then taught at the Univ. of N.C. and at Lehigh, and went to Harvard in 1935. In his spare time there as a research fellow in soil mechanics he edited the *Proceedings* of the First International Conference on Soil Mechanics and Foundation Engineering. His present position dates from September 1939.

P. J. HALLORAN (Dartmouth '19) has served at nine naval stations, three as Public Works Officer and one as a Treaty Engineer in the Haitian Corps of Engineers, his experiences covering the usual wide range for officers in the Civil Engineer Corps. At present, as contract superintendent at Norfolk Navy Yard, he is constructing a 1,000-ft pier, a 350-ton crane, and structural steel buildings.

RICHARD SHELTON KIRBY since 1915 has been in charge of the teaching of engineering drawing at Yale University, his alma mater. He is coauthor with Philip Gustav Laurson of "The Early Years of Modern Civil Engineering," a valuable and fascinating historical volume.

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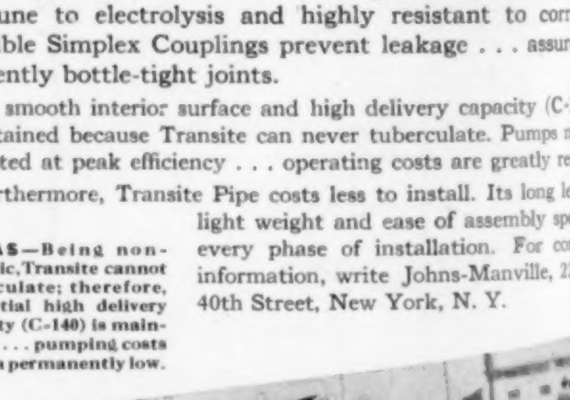

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Naught But the Best

One Engineer's Philosophy as Applied to Dams and Current Doctrines

By the late Thaddeus Merriman

Member American Society of Civil Engineers
Formerly Chief Engineer, Board of Water Supply, New York, N.Y.

In a letter to a friend, written on the train en route from California to the East, early in October 1938, Mr. Merriman gave expression to the following challenging ideas:

"More than ever, in these modern days, is it incumbent on us as engineers to guard our 'science.' On every hand we are confronted with new methods, new schemes, and new devices. To sort the wheat from the chaff is not an easy task. Many feel that their 'learning' does not qualify them to judge these new issues of variegated colors. Others because of an overpowering mass of executive duties delegate them to their subordinates and give little heed to the results. Nothing is further from my thought than to disparage the young man in any manner whatever. I was young myself once and without experience. Then, I felt sure and positive of everything I thought was right. But now after forty years I am able to look back and measure the value of my then effort while, today, there are comparatively few things in the field of engineering of which I am 'dead sure.'

"During these forty years I have kept abreast of the developments and the innovations as they have come. Many have I seen displaced and discarded. Others which have survived are based in large part on catch phrases such as 'fineness modulus,' 'water cement ratio,' 'center of percussion,' 'thousand-year flood,' 'optimum moisture,' and 'electric analogy.' All these and many others find their genesis in the general method known as 'the scientific approach.' This method by its very name must be correct and, *ergo*, it simply cannot be wrong!

"Herein lies a whole story of human psychology. If one can but find some little detail and give it a name he has made a great discovery! For the past ten years or so our colleges have been teaching this method to our young men and have brought them to believe that all these things are true as gospel and that if they but follow them they will be engineers *par excellence*.

"Another most unfortunate trend is the ever-increasing use of results based on tests of models. I do not decry the making of such tests because I have employed as many as most, and am even able to claim a small share in the first experimental model of a spillway built in the United States. Models are excellent tools but the results they indicate are far from absolute and can only be interpreted in the light of personal experience with actual structures. That unfortunately is not the general procedure today. I have done as much work as most in experimental physics, chemistry, hydraulics, and electricity, while long before the 'science' of 'soil mechanics' was heard of I tested soils and experimented with them. The difference between the 'scientific approach' and my view lies simply in the fact that the former if not based on laboratory results is predicated on analogical reasoning. Neither of these methods takes into account the results of actual experience and so they are dangerous in inexperienced hands. Often are they like two-edged swords.

"Analogical reasoning is a species of logic based on the East Indian mentality. As Buddha, in the image of God, resembles a man, therefore man is like God. So also is a dog like a horse because he also has four legs. Similarly, as an electric current is passed through a body of water representing the foundation of a dam the resulting 'potential flow net' is said to be like that of water passing through an actual foundation. Perhaps; but in all probability not. Certainly no drop of water ever moved first backward and then forward on its way through any foundation. Yet that is exactly what many of the ions carrying the electric current do. In spite of this basic difference this method is nevertheless called an 'analogy' and results obtained by means of it are being used for purposes of design. If ever an analogy is to be wholly true both sides of it must be exactly alike in all particulars. If this be the case then, of course, they will be the same thing! Only by considering all the points of difference between two procedures said to be analagous is the truth found from either. Modern methods consider only the points of similarity!! By an argument of like nature Einstein claims to have proven that gravitation equals inertia, and that the one is the same as the other!

"On these matters I have now written enough, but they are a necessary introduction to the conclusion which is to follow. In nearly all engineering procedures we have, during the past ten years or so, seen marked and steady progress in most lines except in that of dam construction, and particularly so in the building of earth dams. In this field there are more styles and fads than there were colors in Joseph's coat. It is absolutely impossible that

all the views expressed in the varied designs of earth dams can be right because many are diametrically opposed while others vary widely from each other. Many of our recent structures, I fear, are less good and stable than those of several generations back. The present state of mental instability is directly traceable to the teachings which are served out to our young men and to their subsequent employ by them without guidance based on either experience or knowledge respecting structures of the past. How this situation is to be improved depends in large part upon the willingness of men of experience to guide the effort of the young, on whose shoulders most of the work naturally falls and who in later years will become the men of experience.

"At the moment the field of dam construction is largely dominated by the abstract theorist and the theoretical experimentalist. Here and there I fear that sad consequences will result. No mistake in designing and building a dam is permissible. Design and construction go hand in hand. Both must be perfect if a safe structure is to result.

"Every dam should be 'safe beyond peradventure.' But no dam will necessarily be safe if based wholly on theoretical design formula. Neither if a dam be perfectly designed will it be safe unless built as intended by the designer by men who understand both design and construction. The designer and the constructor must work together. A perfect design can easily be destroyed by hasty construction, while speed, which we worship today, always makes for slipshod work and often introduces conditions which no amount of designing can make proper or adequate allowance for.

"Dam construction in essence is an art and not a science. No two dam locations present the same features nor are the same materials available. No matter how long the experience of a man with one material at one location he cannot safely design and build a dam. Only after experience at several locations will he learn the great lesson that attention to the smallest details is of the essence of success. Some men never learn, while others learn poorly. Few indeed learn everything well.

"By this time I have no doubt that whoever may read these words will wonder what they are all about and what, if any, moral they point. For myself I am clear that they point a way in which the broad outlines of the situation can be met and in which progress will be possible.

"To begin—the building of every dam should be entrusted both as to design and construction to a responsible and experienced man. He should start the job, make the preliminary investigations, design the structures, and build them. From first to last he should be responsible for every detail. Beginning the job he should complete it. With adequate assistance and with the advice of consultants of experience, the complete and entire responsibility should be his. The plans he prepares should not be subject to review or change except with his complete concurrence. Plans that are subject to the scrutiny of many persons always emerge as compromises and no compromise is ever right.

"Above all no dam designed by one engineer should be constructed by another, while even more importantly, no engineer should ever be entrusted with the building of any dam as the constructor in charge of the forces doing the work. Strange as it may seem, whenever an engineer is put in charge of a construction he will do things and countenance procedures he would never permit on the part of a contractor. Every engineer so placed should be subject to the same type of inspection as that generally imposed upon a contractor. A set-up lacking such inspection and the supervision of the designer can never be a first-class job.

"Every dam should be of the best—a Rolls-Royce and not a 'flivver.' Unfortunately however, most dams are in the latter class because the engineer continually harps on economy. It is a fetish he worships. But this is a factor quite aside from the main issue. If there is not money enough to build a first-class dam of unquestioned safety then the engineer should advise against the project. But how often does that happen? Rather does he seek to build the dam by cutting it to the cloth of the money available. Thus are second-class structures produced even when other conditions are favorable.

"This view of economy often results in cross sections with slopes too steep, in curiously placed materials, in spillways too small, in slope protection too light, in freeboard inadequate, and in foundations poorly prepared. It is further reflected in the use of doubtful materials and in improper construction methods. Speed spells economy but speed does not produce quality. A two-dollar pair of shoes is not as good or as serviceable as a six-dollar pair. For ourselves we never buy the cheap variety, but to our clients we always recommend the cheapest dam.

"It is to be hoped that the day is not far distant when the engineer will come to understand and intuitively feel that his basic duty forbids him to design and build any dam unless it will be safe in every particular. Engineering when applied to dams is not the art of producing the most dam for the least money but the safest dam irrespective of cost. Any other view loses sight of the fundamental that the responsibility of the engineer is fourfold; never should his conscience rest easy unless to the fullest measure he completely discharges his duties, (*a*) to the public, (*b*) to his client, (*c*) to his profession, and (*d*) to himself.

"These duties are fourfold and coordinate. None is higher or more important than the other. In guarding the public interest the engineer also guards his client, his profession, and himself. His duty does not lie only in saving a maximum of his client's money. It demands absolutely that the public be afforded a maximum of safety. If the client is unwilling or unable to pay for that maximum then he should not have that dam. And what is true in the case of a private client is just as importantly true when the engineer acts for public authority—he must still protect the public—no one else can perform that function.

"To meet this fundamental responsibility the engineer must by truthful introspection steer his course without regard to self interest, and free from every influence except his duty and his conscience. Like a judge on the bench he may not advocate his personal views with respect to his own theories or what he may consider to be his own discoveries. He may base his decisions only on established law and proven precedent.

"To steer this course the engineer must sacrifice his own personality and whatever of pride he may have in his own unproven developments, discoveries, or schemes. Than this there is nothing more difficult. It far transcends all technical problems and is the fundamental on which the profession of engineering must be based. There is nothing of logic in any other position, and the principles of ethics confirm it.

"Sincerely yours,

"THADDEUS MERRIMAN"

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NUMBER 12

The Lake Washington Pontoon Bridge

World's Largest Floating Bridge to Provide Shortcut Highway Approach to Seattle

By CHARLES E. ANDREW

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
PRINCIPAL CONSULTING ENGINEER, WASHINGTON TOLL BRIDGE AUTHORITY, SEATTLE, WASH.

BRIDGING a large body of water like Lake Washington with a floating structure carrying major highway traffic is a unique undertaking that rouses the interest of engineer and layman alike. Costing but one-fifth as much as an equivalent bridge on piers, the unusual design is amply justified on economic grounds. In the present article Mr. Andrew presents a general review of the project and discusses a number of interesting design problems. Next month, a second article will be devoted to construction methods.

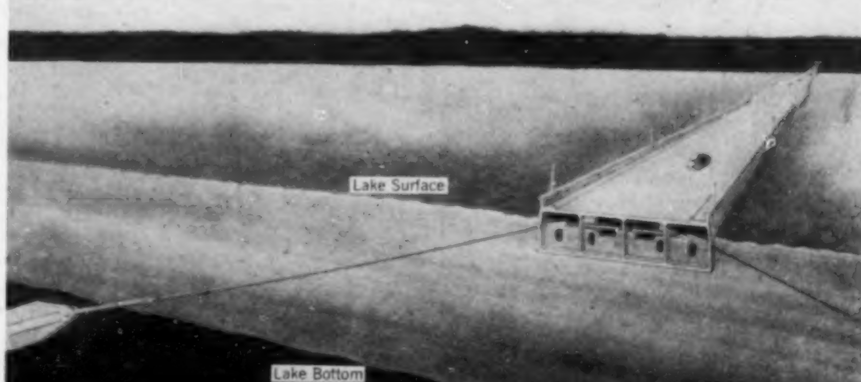
SEATTLE, with a population of 420,000, is the third largest city on the Pacific Coast. It lies mainly between Puget Sound on the west and Lake Washington on the east (Fig. 1). To the east of Lake Washington rise the Cascade Mountains, and beyond them lies the vast rich empire of eastern Washington. Excellent state highways have been constructed to eastern Washington east of North Bend. West of North Bend and to the east shore of Lake Washington, however, the road has poor alinement and steep grades. Lake Washington is approximately 22 miles long, and highway traffic from eastern Washington bound for Seattle is now compelled either to drive around the lake or to take a ferry across it.

Inasmuch as the center of population of Seattle is almost exactly opposite the center north and south of the lake on the west side, and the proper terminus of the highway to eastern Washington is only slightly south of the center of the lake on the east side, it is evident that a bridge across the lake near its center, north and south, will provide the quickest and shortest route into Seattle from the east. Fundamentally, this is the reason for the location selected. A location several miles to the south, which would have been somewhat less expensive because it utilized the projecting point of Seward Park, was studied. However, this location would have saved less than half the mileage and would have required traffic to travel several miles more through Seattle streets to reach the center of population and the waterfront development on Puget Sound. The proper location was obviously on a line as far north as possible while still utilizing the support of Mercer Island.

The location finally adopted (Fig. 1) starts at the intersection of Day Street and Rainier Avenue in Seattle, which point is approximately $1^3/_4$ miles (by existing arterial streets) from the principal waterfront of Seattle and $1^1/_2$ miles south of the center of population. The center line runs eastward on Day Street on elevated roadway and viaduct to the west margin of Yakima Avenue, where it enters a twin bore tunnel under Mt. Baker Ridge to a point between the Lake Washington Boulevard and 35th Avenue South. Day Street was selected because it provided the shortest tunnel and afforded portals in ground subject to a minimum amount of slide action.

From the east tunnel portal the roadway is carried on elevated fills, viaduct, and truss structure to a point approximately 630 ft off the west lake shore, where transition is made to the floating structure. The latter continues over the west channel of the lake for a distance of 6,560 ft to a similar truss, viaduct, and fill construction extending eastward from a point 520 ft off the east lake shore. A floating movable pontoon to afford a 200-ft clear waterway is provided for navigation of major ships, and a 200-ft opening with 30-ft vertical clearance is provided near each shore under the fixed steel spans for pleasure craft.

The center-line location continues eastward from the west channel over a new four-lane highway on Mercer



SECTIONAL PERSPECTIVE OF PONTOON STRUCTURE AND ANCHOR

Island to the east channel of the lake, which it crosses on a conventional steel and concrete bridge 1,360 ft. long. From the mainland the project continues over a four-lane highway to Mercer Slough, which is crossed by a 2,500-ft concrete viaduct extending to the east end of the project. The total length of the project is approximately $6^1/_2$ miles.

Inasmuch as there are comparatively few major floating bridges in existence, and in view of the general instability of floating things in the public mind, it is natural for the layman as well as the engineer to ask the question, "Why was the floating type of structure adopted?"

In approaching a problem such as this, the first thing that must be determined by the engineer is the question of public necessity. The physical barriers already described obviously indicate the necessity for a bridge of some type if the traffic is large enough. Extensive traffic surveys conducted by the Division of Highways and checked by the firm of Coverdale and Colpitts of New York indicated that more than 1,000,000 vehicles annually would realize a great saving in time and distance, and large areas for desirable residential development would become immediately available if the project were constructed. These surveys further indicated that an annual income of approximately \$380,000 might be conservatively expected the first year. Such an amount, with anticipated annual increases, is sufficient to pay interest on and amortize in 30 years a sum of approximately \$5,000,000. Bond syndicates were found that were willing to loan approximately that amount at around 4 per cent interest, and the Public Works Administration was willing to make a grant of 45 per cent.

A total amount of slightly over \$9,000,000 was therefore available to the state for the project. No other funds were available. It was immediately evident to the engineers that to construct a bridge on piers over the west channel (over 8,000 ft long) would be too expensive, if not impossible, owing to foundation depths approaching 400 ft. (The profile of the west channel shows water depths increasing to 200 ft in a distance of approximately 1,000 ft from the west shore, and remaining approximately constant for 3,500 ft eastward. Throughout most of this distance the bottom is a medium soft clay to a depth of some 150 ft.) Cost estimates of such a crossing on piers approached \$18,000,000. The total cost of the adopted design is set at \$8,854,400, of which \$3,600,000 is for the floating structure. The cost of the floating design over the west channel is therefore approximately only 20 per cent that of a bridge on piers.

The next question to be decided was, "Is a floating bridge feasible, safe, and of such a nature that the public will travel over it?"

The first step in answering this question was to make a study of Lake Washington to determine what physical forces would have to be met to make the bridge stable

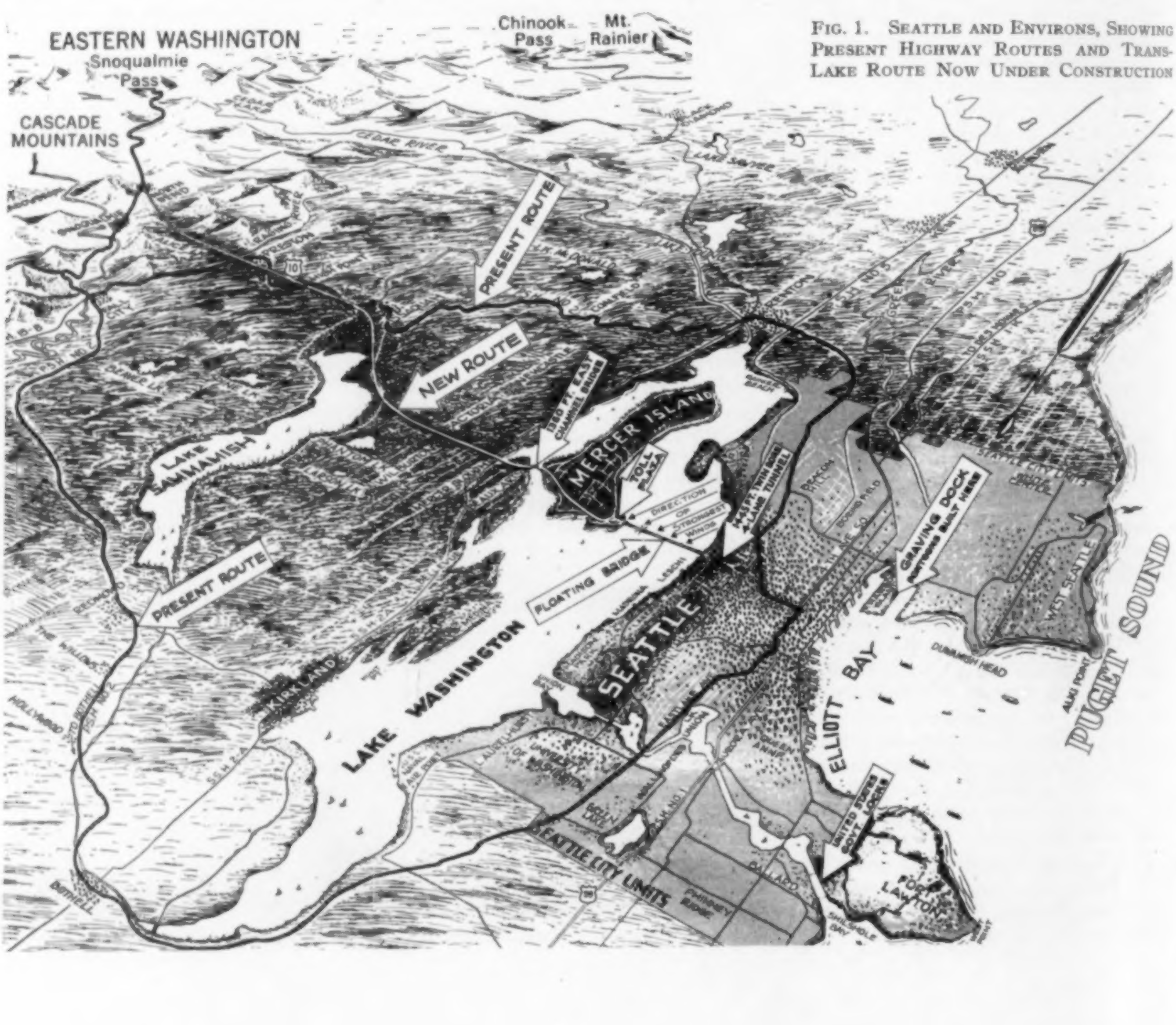
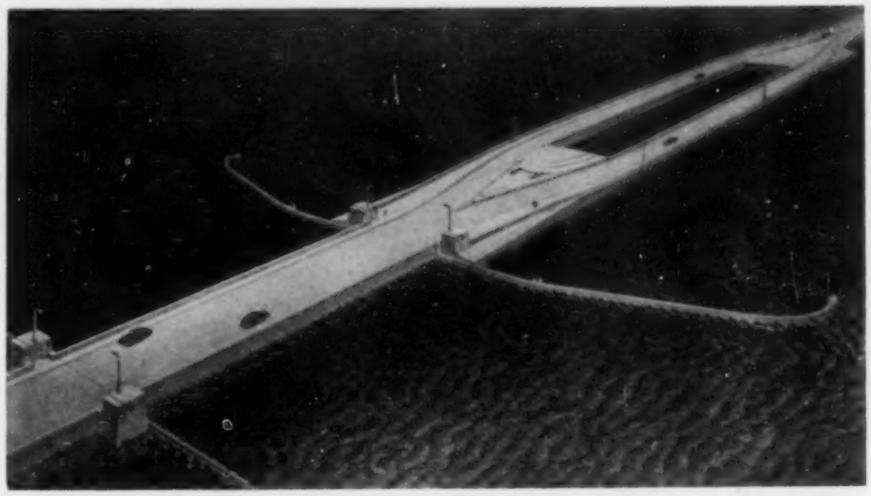


FIG. 1. SEATTLE AND ENVIRONS, SHOWING PRESENT HIGHWAY ROUTES AND TRANS-LAKE ROUTE NOW UNDER CONSTRUCTION

and safe for a long term of years. Fortunately, the U.S. Weather Bureau has kept extensive records of temperatures and wind velocities on the lake over a period of 47 years. In addition, the Sand Point Air Port has studied such features as wind velocities and wave action in connection with its operation of airplanes which take off and land on the lake. Ferry boats have also operated on the lake for years as well as countless pleasure craft. Much information was available from these sources. At once many favorable natural conditions were evident, as follows:



THE DRAW STRUCTURE, DESIGNED TO OPEN IN $1^1/_2$ MINUTES, WILL PROVIDE A 200-FT OPENING, WITH UNLIMITED VERTICAL CLEARANCE, FOR OCEAN-GOING VESSELS

1. The lake water is fresh and pure, containing no chemicals.
2. There is no current or tide.
3. The lake level is controlled to a maximum variation of surface level of approximately 3 ft by the Lake Washington Canal Locks.
4. There is no drift or ice, except thin shore ice.
5. The lake bottom is of such character that excellent anchorage can be obtained.
6. Temperature variations, of both atmosphere and water, are comparatively moderate. Temperatures for air range from 3 F to 98 F and for water from 32 F to 75 F, the maximum difference between air and water being about 38 F for a period of only a few hours. (Lake temperatures were taken 6 ft below the surface.)

All these conditions are extremely favorable and led the engineers to believe that Lake Washington is subject to natural conditions that make a floating structure particularly suitable. The only external forces requiring attention were those induced by wind, waves, and roadway traffic. The study of wave forces is of course the most complicated.

WAVE FORCES CAREFULLY STUDIED

All available authorities on wave characteristics, their development, height, and velocities, were studied. But it was found that practically all information on the subject applies to waves in the ocean or in arms of the ocean, as they affect ships or shore structures such as docks and breakwaters. Very few data are available on waves in smaller bodies of water such as inland lakes, and a study of the problem readily shows why. Natural conditions governing the development of waves, such as size, outline of shore line, length of "sweep" or "fetch," depth of water, relation between major axis of lake and direction of prevailing wind, with various combinations of these or other effects, are applicable only to the individual lake. In other words, every lake is almost sure to be unique in these respects. It was therefore necessary to devote intensive study to Lake Washington, applying known wave characteristics as far as possible to actual conditions existing on that body of water.

From Fig. 1 it will be seen that the long axis of the lake lies in a north and south direction. The Weather Bureau records show that winds of greatest intensity come from west of south. The wind velocities have been recorded continuously at Sand Point Naval Air Station since 1929. During the storm of October 1934, which is stated by the oldest residents to be the highest wind within their memory, an instantaneous gust velocity of 87 miles per hour was recorded. The highest average velocity for a period of one hour during this same storm was 47 miles per hour. The effect of extreme gusts was to blow the tops off the waves. It is probably conservative to assume the maximum velocity (over a long enough period to effect wave height) at 75 miles per hour. Winds from the north are not of high velocity, the highest recorded in ten years being approximately 40 miles per hour.

Referring to Fig. 1, it will be noted that the Seward Peninsula projects into the lake and almost entirely covers the south southwest projection of the axis of the entire floating structure, and in so doing limits the fetch from that direction to a maximum of approximately $2^1/_2$ miles. This physical condition is important, as the fetch is a principal factor in wave development. The two other important factors are wind velocity and depth of water. Beyond depths of 40 or 50 ft, however, the inverse effect of depth on wave height is negligible. Depths along the floating structure vary from a minimum of 68 ft to a maximum of 215 ft and in consequence the depth factor can be neglected.

The only authoritative observations of wave height on Lake Washington, besides those taken on the test barge, were made by the Sand Point Naval Air Station. They report waves during the 1934 storm of 6 ft in height with possible peaks of 8 ft, the wave form being exceedingly choppy, with maximum wave crest lengths of 30 to 40 ft.

It should be noted that the fetch in a south wind from Seward Peninsula at Sand Point is approximately $8^1/_2$ miles, while at the bridge center line it is only $2^1/_2$ miles. It is further noted that the application of formulas for wave height, proposed by authorities on the subject, some involving only wind velocity and others involving both wind velocity and fetch, all result in wave heights of somewhat less than 6 ft. For these reasons it was decided to assume a wave height of 6 ft (plus the effect of a 90-mile wind on the exposed surface of the pontoon) for use in the design of cables and anchors. Because of the great depth of water, dynamic effect of waves was neglected, and wave pressures were determined by computing the difference in hydrostatic heads on the submerged surfaces of the pontoon.

The principal forces creating stress in the cables are thus the lateral and vertical motion of waves and the lateral force of wind. The principal forces resisting movement of pontoons are resistance of cables, inertia of pontoons, friction of pontoons on water, and re-

sistance by plowing effect of pontoon through water against vertical sides.

The tendency of a passing wave is to set up an oscillating motion in the pontoon, first stretching one cable and then the opposing one. In order to create stress in the cables, the pontoon must be moved. In creating this movement a large amount of the lateral wave force is absorbed by the three last-mentioned resisting forces. In fact, it is found that these resisting forces together exceed that of the cables themselves. In the design of the cables and anchors, however, these resisting forces are neglected and held in reserve as an added factor of safety.

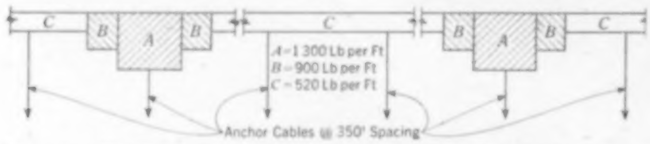


FIG. 2. HORIZONTAL LOAD DIAGRAM FOR COMPUTATION OF ANCHOR STRESSES

In determining the horizontal thrust created by a wave, it is assumed that the wave retains its form, in so far as work is concerned, as it passes under the pontoon. It is further assumed that the pontoon will remain on a level keel both lengthwise and crosswise. To arrive at the horizontal thrust per unit of length, the pontoon is placed at successive stations over the entire wave cycle and the horizontal hydrostatic pressures are computed on each face in successive positions. The difference between these pressures is the resultant thrust per unit of length at each position.

The length, crest to crest, of a 6-ft wave is assumed at 72 ft; crest height above normal lake level, 3.6 ft; and trough depth below lake level, 2.4 ft. The duration of a complete cycle is taken as 4.24 seconds.

In arriving at a proper load diagram, which would safely simulate the action that might be expected from 6-ft waves as they exist on Lake Washington, it is necessary, from data assembled, to visualize what actually happens when the choppy wave forms intersect the vertical side surfaces of the pontoon. Assuming that the maximum continuous wave crest length is 50 ft (maximum observed is estimated as 30 ft), it is safe to conclude that on each side of the crest center full differential hydrostatic thrust will (at the instant of impingement) exist for a distance of 25 ft. Directly on each side of this full crest area, the differential pressure will start to decrease and so continue over a certain distance (depending on the degree of chop), until it becomes zero. Beyond this point the direction of differential force will reverse, increasing in negative intensity to, and continuing through, the wave trough to a point of reverse and another cycle.

Thus it can be seen that choppy waves have a very great tendency to neutralize one another so far as horizontal thrust is concerned, and the average resulting thrust per lineal foot of bridge becomes very much less than the unit thrust per foot created by a wave of any given height.

Obviously, with the many variables in the problem, it is impossible to apply any exact mathematical solution; and judgment—bounded on one side by economy of design and on the other by proper safety factors—must be largely responsible for an answer.

Full consideration of the many factors involved resulted in the adoption of the horizontal load diagram shown in Fig. 2. Area A simulates the horizontal differential thrust of 200 ft of a 6-ft wave crest plus wind. Areas B represent 60 per cent of a 6-ft wave plus wind. Areas C are continuous between B areas and represent 30 per cent of a 6-ft wave plus wind. The cables are designed for this load in its most adverse position, as applied to an elastic beam of indefinite length on yielding supports. It will be noted that all loads are positive and no areas of negative thrust are considered to exist throughout the entire bridge length. The omission of negative thrust areas at once constitutes a very much greater load than can actually exist. This, coupled with the omission of inertia resistance and other resisting forces mentioned, greatly increases the factor of safety.

Moments and shears in the pontoons provide for the lateral and vertical forces of dead and live loads and wind and wave forces. Lateral and vertical displacements estimated under the above loadings indicate much less movement than is experienced in moderately long-span suspension bridges. At wind velocities of 60 miles per hour only very slight movement will be noticeable under traffic—and in any case when the wind is blowing at 60 or more miles per hour traffic is practically at a standstill everywhere. In so far as traffic comfort is concerned, movements in the structure for wind velocities over 60 miles per hour need not be considered in any bridge.

The pontoons, in general, are cellular flat-bottom boats, 59 ft wide and 117 to 378 ft long, with bottom slabs and outside walls 8 in. in thickness. Regarding the watertightness and length of life of such structures in fresh water there can be no doubt, when one considers that concrete barges with hull thicknesses of 3 and 4 in. have been in successful service in salt water for 20 to 25 years.

NAVIGATION PROVIDED FOR BY RETRACTABLE PONTOON

To provide passage for ocean-going vessels, one pontoon is designed to be retracted into an opening in an adjacent pontoon). A number of unique design problems were encountered in this structure. Briefly, the moving pontoon is connected to the adjacent or fixed pontoon through horizontal and vertical trunnions running in grooves in the latter. These trunnions are designed to take moments and shears developed by wind and wave forces as well as unbalanced live load. When closed, the outboard end of the moving pontoon is locked to provide vertical and horizontal shear and horizontal moment. Electric power is provided to complete an opening in $1^1/_2$ minutes.

In arriving at this design for the navigation opening, many different types of floating structures, including a submersible type and both bascule and lift fixed types were considered. The principal reasons for selecting the moving-span design adopted were low cost, retention of the lateral elasticity of the bridge throughout its length, and simplicity.

The Lake Washington project has been financed by the Toll Bridge Authority of the state of Washington. Governor Clarence D. Martin is chairman. The project was designed and is being constructed under the general direction of Lacey V. Murrow, chief engineer of the Toll Bridge Authority, also director of highways. The author is chairman of the consulting board and principal engineer in charge of design and construction. Members of the consulting board are: R. B. McMinn, Portland, Ore., Rear Admiral L. E. Gregory (retired), Olympia, Wash., and R. H. Thomson, Seattle, Wash. R. M. Murray is bridge engineer for the state. George A. Gregory is project engineer for PWA, and L. R. Durkee, chief resident inspector for PWA.

General View of Pier, with Backfilling up to High-Water Level. Old Wharf Is at Right

Steel Sheet Pile Wharf at Rimouski, Quebec

General Description of the Project and the Methods of Construction; Correlation of Test-Pile Data with Actual Driving Record on Main Piles

By Jean P. Carriere

Assistant Engineer, Department of Public Works of Canada, Quebec, Canada

From data on a single test pile, engineers on the Rimouski project predicted with an error of only 4 per cent the actual total driving time for the 1,500 main piles required in the job. The method by which this remarkably accurate estimate was made is explained here in detail. Other preliminary testing work, important in the design of the pier, is also discussed. In the remainder of the article, Mr. Carriere describes the layout of the pier, important features of its design, and methods of construction.

Rimouski Harbor is situated on the south shore of the St. Lawrence River, 180 miles east of the city of Quebec, and is the only river port below Quebec provided with berthing accommodations for ocean-going steamers. By 1935 its single wharf was taxed to capacity with an annual export traffic of 150,000 tons of lumber, pulp wood, and timber products, and expansion of facilities became imperative. Berthing accommodations were seriously limited, there was practically no storage ground on the wharf itself, and railroad facilities were inadequate.

It was agreed that the following improvements were necessary to permit actual and anticipated traffic in the harbor to operate under favorable conditions: increased area of storage ground and sheds, increased berthing space, increased railroad facilities, and increased dredged area. Eight schemes for effecting these improvements were prepared, each presenting advantages and disadvantages. The plan finally adopted is shown in Fig. 1.

The location of the new pier was established on the recommendations of captains of vessels calling regularly at the harbor. The minimum practical width for the turning basin was fixed at 620 ft, in order to permit berthing and clearing of incoming and outgoing vessels while other vessels are actually berthed along the faces of the old and new piers on the basin side.

The length of the approach to the pier was established on the recommendation of the shippers in order to permit the construction of suitable storage ground, the area required having been estimated at 800,000 sq ft.

Pier width was established on the recommendations of Canadian National Railway officials and trucking firms, 100 ft being found the minimum necessary for two lines of tracks, shed space, and lanes for motor-truck traffic.

The additional length of berthing space required was estimated at 3,500 lin ft by harbor officials. The scheme adopted will add 3,680 lin ft of berthing space when the improvement works are completed.

Main disadvantage of the adopted plan was the extensive quantity of dredging required, there being 350,000 cu yd to be removed for the turning basin alone. The original depth of water at the outer end of the new pier was only 7 ft during low water of spring tides.

One of the main considerations in choosing a suitable type of structure was the fact that the position chosen for the new pier was very shallow, the inner end being at the low-water line and there being only 7 ft of water at the outer end. Most types of construction required that the entire site of the pier itself be dredged to 25 ft below L.W.O.S.T. (low water of spring tides), which is the ultimate depth of the basins. This would have been true, for example, of timber construction—but timber was out of the question in any case on account of the presence of marine borers, which had already been the cause of extensive damage to the old wharf.

A concrete structure would also have required dredging the site of the pier. Moreover, the launching of concrete cribs presented considerable difficulty in that it would have been necessary to dredge a channel to bring them to the site of the pier. As for building such cribs in place, the cost of sufficiently strong falsework was found to be excessive. The tide has a range of 16 ft at Rimouski and this influences the carrying out of the work to quite an extent.

The most favored type of construction, and that finally adopted, consisted of steel sheet pile walls, to be driven before dredging the basins, thereby using the existing material of the bottom as part of the fill.

More than 80 borings, distributed over the site of the work, revealed a continuous stratum of stiff clay to beyond the depth to be reached by the steel sheet piling

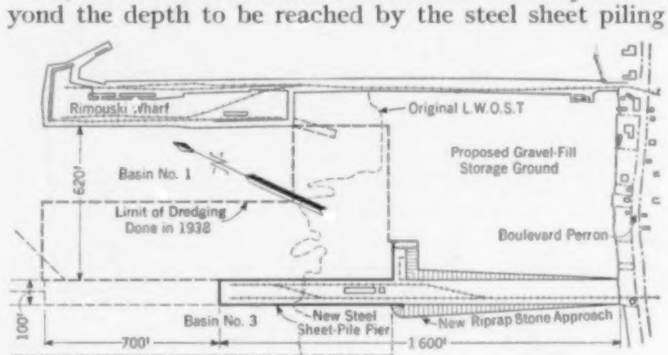


Fig. 1. Rimouski Harbor Showing, in Light Lines, Facilities Existing in 1936, and in Heavy Lines, the New Improvements

GENERAL VIEW OF WALLS DURING DRIVING

(Fig. 2). There were few boulders. The material composing the sea bed is Leda clay—a marine clay formed during the closing stages of the last glaciation and occurring at many places in the St. Lawrence Valley, both below and above sea level. It is a tough, bluish grey, and fairly homogeneous, showing only faint traces of stratification.

Tests on small hand specimens showed that this clay was of a fairly stable consistency, and did not exhibit any peculiarities in remolding. Similarly, although close watch was kept during the driving of test piles, no "puddling" of the clay was observed at the surface. These tests were all of considerable significance in confirming that the clay was not one of the peculiar preconsolidated Laurentian clays found elsewhere in the St. Lawrence Valley.

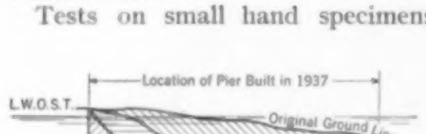


FIG. 2. SUBSOIL CONDITIONS ALONG LINE OF NEW PIER

Undisturbed samples were also taken at various locations and at depths of from 20 to 40 ft. The percentage of water in the clay was found to be fairly constant at all depths, and averaged over 18 per cent. This was of considerable significance in showing that some lubrication between pile and soil would take place in driving and would reduce the friction between pile and soil. Hydrometer analyses for grain-size distribution showed samples to be fairly uniform in character, 50 per cent or more of each sample being silt or coarser material (Fig. 3).

All samples were classed as "tough clay." A shear strength of 1.1 tons per sq ft was obtained from a typical sample which was tested at the Soils Laboratory of the U.S. Engineer Office at Eastport, Me.

Steel test piles of the type intended for use in the pier were driven in different parts of the work, and the driving records for all were similar. These tests, and the curves obtained from them, were useful in estimating the speed and cost of driving the steel sheet piling walls, and also made possible an intelligent choice of equipment for carrying out the work. Their results are presented in Fig. 4 and will be discussed later in detail.

Adjacent to one of the test piles a large hole was dredged in the clay to provide a test of the material in situ. The side of the hole, which included the single pile exposed on one face, was slightly curved in plan, the hole being about 80 ft wide in this direction and 35 ft measured away from the pile. Dredging was carried to 20 ft below L.W.O.S.T. adjacent to the pile. The face containing the pile was finished off as nearly vertical as could be managed by the dredger, the final face being almost vertical for at least three-quarters of the depth. Although exposed to varying tidal currents and the effects of a 16-ft tide, the hole remained exactly as it was when first made for a period of over two months, during which time it was kept under close observation.

Clay excavated from the hole was dumped onto the foreshore at low-tide level, there forming a heap of "clay lumps" about 10 ft high. Although this loose heap was washed every day by two tides, it retained its original form for three months, the angles made by the sides being about 45 deg.

The information assembled in this way, although somewhat unusual in nature and not accurately correlated, suggested that assurance could be placed in having throughout the work a stiff, consistent clay, very stable if undisturbed, and having a reasonably high shear strength.

DESIGN AND CONSTRUCTION OF THE PIER

The pier was designed as a simply supported wall, driven into the ground and braced by tie-rods (see Fig. 5). The penetration required below the ultimate dredged bottom was 19 ft 6 in. With the main tie-rods located 6 ft 6 in. above L.W.O.S.T., the maximum calculated bending moment was 1,638,000 lb-in. per lin ft of wall, and the total pull on the tie-rods was 22,300 lb per lin ft. This called for steel sheet piling rolled of special high tensile steel that would permit the use of a working stress of 30,000 lb per sq in., and having a minimum section modulus of 54.6 in.^{3} per lin ft of driven wall.

The chemical composition of the steel for the piling was specified to be as follows: carbon, 0.20 to 0.26 per cent; silica, 0.20 per cent maximum; sulfur, 0.05 per cent maximum; phosphorus, 0.05 per cent maximum; manganese, 0.70 to 1.00 per cent; copper, 0.30 to 0.60 per cent; and chromium, 0.30 to 0.60 per cent.

An ultimate tensile strength of 71,000 to 85,000 lb per sq in., and a minimum yield point stress of 54,000 lb per sq in., were also specified.

The layout and arrangement of the walls were made as simple as possible and involved few unusual features. However, the following points are worthy of mention (see Fig. 5):

1. "Top tie-rods," 1$^1/_4$ in. in diameter and 20 ft long, were designed to be placed 2 ft below the top of the piling to reduce vibration in the walls. These rods were to be anchored to concrete blocks set in the backfill and to the steel sheet piling walls, at every sixth pile, by means of a steel wale consisting of two 7-in. channels.

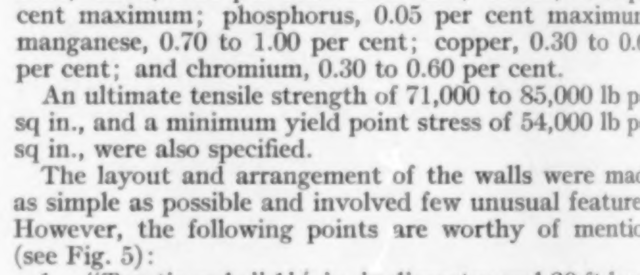


FIG. 3. RECORD OF GRAIN SIZES OF RIMOUSKI CLAY

2. Instead of corner piles at the two outer corners of the pier, specially fabricated T-piles were designed to facilitate the construction of an extension at a later date.

3. All steel other than the piles was specified to be copper steel.

4. All nuts in the structure were specified to be tightened over lock washers, except at the lower tie-rods, where the nuts were specified to be welded to the rods after being tightened in place.

On the basis of the bids received by the Department of Public Works the contract was awarded to the Paradis and Farley Company of Montreal, Que., and work was started on May 15, 1937.

The method of constructing the steel sheet pile walls is clearly indicated in an accompanying photograph. Just inside the line of location of each wall a timber pile-work trestle was erected to carry the drivers and other equipment. These trestles were 20 ft in width, and their decks were at an elevation of 1 ft above H.W.O.S.T. Access to the shore was provided by another trestle 15 ft wide.

Work on the two walls went on simultaneously. The main tie-rods were put in as the walls progressed seawards, as were the wales and the coping. Two pile-driving frames, running on narrow-gage tracks, were employed on each wall, the leading ones being equipped with McKiernan-Terry double-acting steam hammers, No. 10-B2,

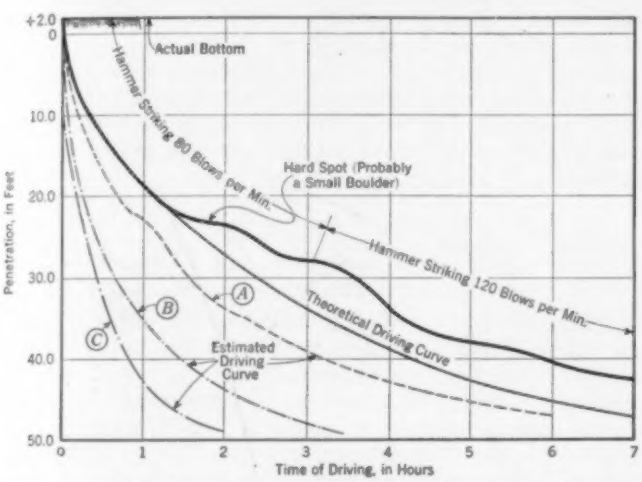


Fig. 4. Driving Test, Test Pile No. I, and Estimated Driving Curves for Work with Heavier Hammers

and the rear ones with No. 11-B2 hammers of the same make. A stationary steam plant was used for approximately the first three-quarters of the length of the walls, and the boilers were then put on traveling frames following the hammers for the remainder of the job.

The piles were unloaded on the old wharf, where they were painted and stacked, and were transported thence to the site of the new pier by scow. There they were threaded in place in panels of 20 by the leading pile-driving frame, the hammer being removed for this operation. The No. 10-B2 hammers were then used to drive them to a depth of about 30 ft, and the remainder of the penetration was obtained with the 11-B2 hammers on the rear frames.

When boulders were encountered, a hole was jetted down to them, a few sticks of dynamite were exploded to crack them, and driving was resumed. Only rarely was it found necessary to cut a pile on account of the impossibility of dislodging an obstruction.

As the walls proceeded seawards the trestles were dismantled behind the driver to be used a second time in the outer part of the pier. The timber piles of the trestles

Driving Piles and Installing Tie-Rods

For Most of the Pier Length, Tie-Rods Extend from Wall to Wall. The Concrete Anchorage at the Right in This View Was Used in the Shoreward End, Where the Pier Widens Out

were driven and pulled from a floating derrick scow, and only a few of them were broken in pulling.

Simultaneously with the work on the pier, the gravel and stone approach construction was carried out from a dump starting at the shore line. With the gravel pit about a mile from the site, eight 5-ton dump trucks sufficed to keep one $^3/_4$-yd steam shovel busy loading at all times. The main fill on the pier proper was placed by the same methods, as a continuation of the approach.

After all the piles were driven, a contract was awarded for dredging the turning basin between the old wharf and the new pier to a depth of 20 ft below L.W.O.S.T. Removal of 350,000 cu yd of material was involved. Equipment used for the dredging consisted of a steam-operated dipper dredge, the bucket having a capacity of 9 cu yd and the power plant and boom having a line pull of 125 tons.

Pile-driving operations were completed in September 1937, and filling operations two months later. Dredging began in November 1937, was interrupted for the three winter months, and completed on June 30, 1938.

Although complete records of every item of the construction contracts were kept, the only unusual records are those of the pile driving. Eight inspectors assisted in keeping these records, in addition to their other duties, one inspector being on duty at each pile-driving plant at all times.

The records kept included the following: (1) driving time, (2) penetration obtained (Items (1) and (2) were kept as close as possible at intervals of 5 ft of penetration), (3) number of blows of hammer per minute, (4) steam pressure at hammers, (5) time of threading, (6) length at which piles were cut off, (7) time employed in cutting piles, (8) repairs to plant (time employed), and (9) loss of time due to lack of steam. A daily synopsis of all these items except (6) was also kept.

The most interesting part of these records is the curve of Fig. 6, in which the average total driving time per pile is plotted against the penetration obtained.

The average final penetration was 42 ft 6 in. Estimated driving time, as obtained from the test-pile records previously referred to, was 164 minutes. Actual average driving time for the same penetration was 171 minutes, an increase of only 7 minutes, or 4 per cent, over the estimated time.

A general outline of the method used in constructing the estimated driving curves will here be given. In Fig. 4, the full line is the actual driving curve for test pile No. 1, which was put down at a location where borings showed the subsoil conditions to be a good average of those to be encountered throughout the work. The

WALLS COMPLETE EXCEPT FOR INSTALLATION OF "VIBRATION" TIE-RODS

hammer used on the test pile was a 5,000-lb, double-acting steam hammer with a computed total kinetic energy of 5,810 ft-lb per blow. For the first 28 ft of penetration, the hammer was striking 80 blows per minute. For the remainder of the penetration, after correcting a slight defect of adjustment in the mechanism, the hammer operated at 120 blows per minute. The energy of each blow was not affected by this change.

"Estimated Driving Curve A", which assumes a regular hammer speed of 120 blows per minute from start to finish, was derived from the actual curve by considering the rate of penetration as proportional to the number of blows given.

ESTIMATED DRIVING CURVES FOR THE HEAVY HAMMERS

The next step was to construct estimated driving curves for the heavier hammers actually to be used on the job. In doing this, the following assumptions were made:

1. The temporary elastic compression in pile head, pile itself, and ground, for piles driven in the same soil with hammers of different effective kinetic energies, varies in direct ratio to the effective kinetic energies of the hammers used.
2. The rate of penetration of two similar piles driven in the same material with hammers having different kinetic energies varies in direct ratio to the effective kinetic energies of the hammers used.

Pertinent data for the application of these assumptions may be presented thus:

	Weight of Hammer, W, in Tons	Efficiency of Hammer*	Gross Kinetic Energy, Ft-Lb	Effective Kinetic Energy, Ft-Lb†	Blows per Min
(1)	(2)	(3)	(4)	(5)	(6)
Hammer used on test pile	2.5	0.69	5,810‡	4,010	120
McK.-T No. 10-B2 . .	5.0	0.77	15,000§	11,550	115
McK.-T. No. 11-B2 . .	6.6	0.81	22,000§	17,820	120

*Efficiency $= \dfrac{W + Pe^2}{W + P}$, in which e is coefficient of restitution of materials (taken as 0.5) and P, the weight of the pile (2.2 tons). †Col. 3 × Col. 4. ‡ Computed. § Rated.

From the foregoing, and taking into consideration the rated number of blows per minute of each hammer, the estimated driving curves B and C (Fig. 4) were drawn for the 10-B2 and the 11-B2 hammer, respectively.

In actual driving, the piles were put down in pairs. Under these conditions (taking the weight of two piles as 4.4 tons), the efficiencies of the 10-B2 and 11-B2 hammers were respectively 0.65 and 0.70, and their effective kinetic energies were respectively 9,750 and 15,400 ft-lb. Moreover, since the ultimate resistance to penetration is doubled in driving two piles together, the rate of penetration for any given effective kinetic energy is reduced by half.

With these data the estimated driving curve of Fig. 6 was constructed. The upper 30 ft of it is Curve B of Fig. 4, corrected for the effects of driving piles in pairs; the remainder is Curve C of Fig. 4, similarly adjusted.

The break in the estimated driving curve at the point where the hammers were changed is clearly apparent.

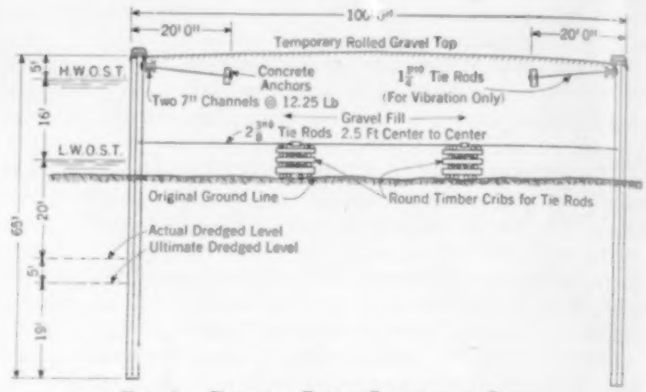


FIG. 5. TYPICAL CROSS SECTION OF PIER

That the actual average driving curve for all piles does not show this break is due to the fact that although the change of hammer was made at an average of 30 ft of penetration, the exact point of change varied from pile to pile sufficiently to smooth out the curve.

To complete the discussion of Fig. 6, it remains to point out the differences between the driving plant characteristics assumed for the estimated curve and the actual characteristics under which the average curve was obtained:

Hammer	Blows per Min.		Steam Pressure, Lb per Sq In.	
	Assumed	Actual	Assumed	Actual
11-B2	120	102	100	85
10-B2	115	80	100	85

This pile-driving record is thought to be of considerable significance, in that it demonstrates clearly the usefulness of driving test piles in preparing for and estimating this type of work, and in selecting the equipment to be used.

The writer wishes to thank K. M. Cameron, chief engineer of the Department of Public Works of Canada, for his kind permission to publish this paper; R. deB. Corriveau, assistant chief engineer of the Department of Public Works, for his most helpful suggestions; L. G. Trudeau, formerly district engineer for the Department of Public Works at Rimouski, and Bruno Grandmont, his successor, for help in gathering the material; H. F. Bennett, district engineer at London, Ontario, for his encouragement and suggestions; Walter J. Manning, chief inspector at Rimouski during the construction of the pier, for keeping most complete records; and last but not least, Robert F. Legget, assistant professor of civil engineering at the University of Toronto, for his help and encouragement.

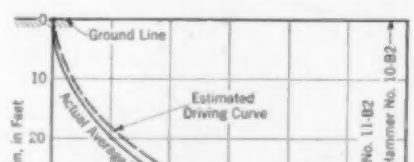


FIG. 6. ACTUAL AVERAGE DRIVING CURVE FOR ALL PILES DRIVEN "IN PAIRS"

Note Close Conformity to Estimated Curve for One Pair of Piles

A Railroad Fights Floods

Southern California Deluge Culminating on March 2, 1938, and Its Effect on Southern Pacific Lines

By W. H. Kirkbride

Member American Society of Civil Engineers
Chief Engineer, Southern Pacific Company, San Francisco, Calif.

It was no ordinary downpour that struck the Pacific coast within a six-day period at the end of February and beginning of March 1938. Over an area of 14,000 sq miles, much of it mountainous, an average of $12^1/_2$ in. of rain fell, with a maximum of over 32 in. recorded at one gaging station. What problems this imposed on the Southern Pacific Lines is graphically recorded by Mr. Kirkbride. To rehabilitate the line, repairing the more than 150 breaches, some of them of major importance, heroic measures were demanded. The unprecedented extent of the damage, the marshaling of all available resources, the methods of emergency and permanent reconstruction—the relating of these unfolds an interesting story. This paper is abstracted from a finely illustrated address before the Hydraulics Division at the San Francisco Meeting last July.

RAILROADS, highways, and private interests in Southern California suffered widespread storm damage during the 4-day period February 27 to March 2, 1938, from floods caused by rains of cloudburst intensity with quick runoff. Central and northern California had just partially recovered from a severe period of rain, snow, and high winds that had extended from the late months of 1937 into January and February of 1938. Much rain had fallen, rivers were high, and the snowfall on the Sierra Nevadas approached a record of 698 in. for the season at Summit station.

Storm damages were reported high; but it remained for the Southern California storm to set a record of destruction and damage many times that of the more northerly storm. The area generally covered by the storm was that shown in Fig. 1, within which the rivers flow over the coastal plain in a generally southwesterly direction. Mountains range in elevation from a few thousand to 10,000 ft. The mountain slopes are steep and generally devoid of trees, with grease and chaparral bush predominating. Large areas have been denuded by fire.

Principal Damage Caused by "Dry" Rivers

The rivers and washes causing the principal damage are shown on the map. They are called dry rivers; that is, during the long dry summer season the flow disappears or becomes no more than a rivulet, but in the rainy season it is torrential and debris-laden. An outstanding characteristic of these streams is their extremely short lengths. The Santa Clara, the longest, is only about 90 miles, while the Los Angeles, the shortest, is 52 miles in length. The gradients of such streams coming down high mountain peaks must of necessity be steep, conforming to the mountain slopes from which they flow; however, their lower reaches through the coastal plain assume the flat characteristics of river deltas.

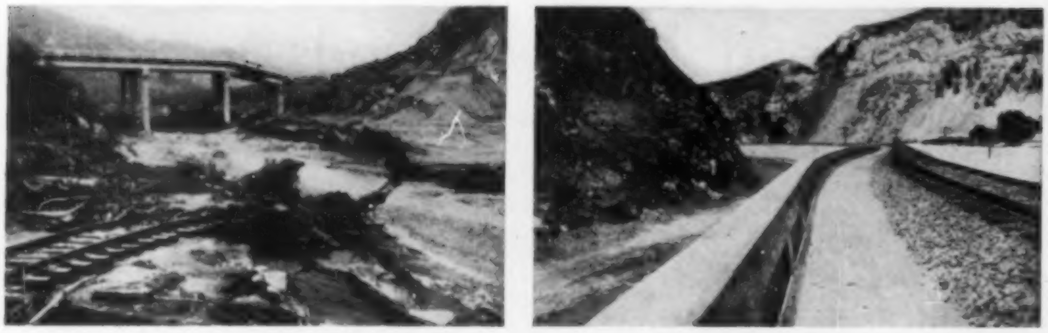
These mountain ranges with their high towering peaks intercept the water-soaked clouds driven inland from the Pacific Ocean and literally rob them of their precious burden of water; hence the existence of the Mojave and Colorado deserts lying to the north and east. There is thus created, during a period of severe storms in this area, a situation involving the following factors of stream flow:

1. Torrential downpour
2. Quick runoff
3. Accelerated erosion
4. Waters surcharged with eroded material
5. A release of material in the sequence of:
   (a) Debris of the larger order
   (b) Gravels and sands
   (c) Finer detrital material
   (d) Sediments

Hence, we have a terrain between the mountains proper and the ocean made up of zones containing these materials in the order of deposition and conforming to the transverse grades under which the stream waters gave up their load; but man steps in before nature has completed the job. The process is continually going on, shifting water courses, alternately filling and cutting down, but the net result is the same—a building up of river bed and adjacent banks.

It is over this mountainous terrain, with its varying modifications and through a heavy population, that the lines of the Southern Pacific Company are located. These comprise four diverging routes from Los Angeles as a center, leading (1) northwest along the coast, (2) north through the San Joaquin Valley, (3) east toward El Paso, and (4) southward as industrial branches. These lines were subject to major washouts involving track and structures. All told, there were over 150 breaches of line, such as steel bridges swept off their foundations; many bridge piers and abutments under-

Problems Along the Los Angeles River, Within the City
Left, What Was Left of Union Pacific Tracks, Used Jointly by Southern Pacific, near Macy Street; Right, Reconstruction at First Crossing, New-Type Permanent Pier and Temporary Bridge



WHAT HAPPENED IN SOLEDAD CANYON
Left, Devastation, and Right, Reconstruction

mined; much trestling swept away; roadbed and track structure destroyed; tracks, engine houses, and shops buried in sand; tunnels filled with debris and logs; signal and communicating lines demolished; and landslides engulfing tracks.

PRECIPITATION OVER STORM PERIOD

Heavy precipitation took place on the night of February 28–March 1, owing to the passing of a "cold front" which moved in from the northwest. This reversed itself and came in as a "warm front" advancing northeasterly. The climaxing deluge of rain occurred on the second, resulting in the destructive flood responsible for the major damage to property and loss of life. Rain continued to fall on the third and fourth, there being occasional showers up to the thirteenth, when the weather cleared. At the end of this latter period, namely, on March 12, heavy precipitation created a secondary flood which added to the confusion.

Summarizing the total precipitation for the 6-day main storm period, the records show that the average for the 220 stations reporting was 12.47 in. There were no stations falling within the range of $^1/_2$ to 1 in.; 3 stations came in the 1 to 5-in. range; 96 stations in the 5 to 10-in. range; 62 stations in the 10 to 15-in. range; and 59 stations in the 15 to 32.20-in. range. In all, 25 stations reported over 20 in.

Plans to put the railroad lines back into operation and to repair the havoc wrought by these floods were quickly outlined. Officers upon whom rested the responsibility of rehabilitation made their way to Los Angeles by special train and automobile, and there a central working organization was established in the Division Superintendent's office, where some one in responsible charge was assigned continuously throughout the 24 hours of the day. From these headquarters engineering and maintenance officers supervised the field work, utilizing both automobile transportation and track motor cars.

Daily, between the hours of 8 p.m. and midnight, officers that were available conferred with executives, reviewed the day's reports, and formulated the next day's work. Progress reports were reviewed, tabulated, and illustrated on charts; a scheme of progress photographs was put into effect. This central organization also included engineering and drafting forces, timekeepers, auditors, material clerks, and representatives of the news and publicity bureaus. Freight and passenger representatives were likewise constantly in touch with the situation.

The problem of rehabilitation was attacked in the first instance by dispatching to outlying points work trains in charge of maintenance officers from adjacent divisions, with augmented forces of bridge, track, signal, and telegraph men, equipped with necessary tools, pile drivers, and other bridge equipment and material.

Conforming to established custom these officers were on their own; it was their responsibility to open up the line in the least possible time, and to spare no expense. For instance, the division engineer of the Tucson Division (located 502 miles from Los Angeles) proceeded north out of Yuma with repair forces and a work train, restoring the roadbed and driving temporary trestles as the need arose. He thus opened the line to near the Santa Ana River at Colton, Calif. (Fig. 1).

The Coast Division with headquarters at San Francisco, handled the situation south to Santa Barbara, thence toward Los Angeles. And as soon as the Coast Route was opened, these forces were used to reinforce the Los Angeles Division. In the meantime, the San Joaquin Division, with headquarters out of Bakersfield, aug-

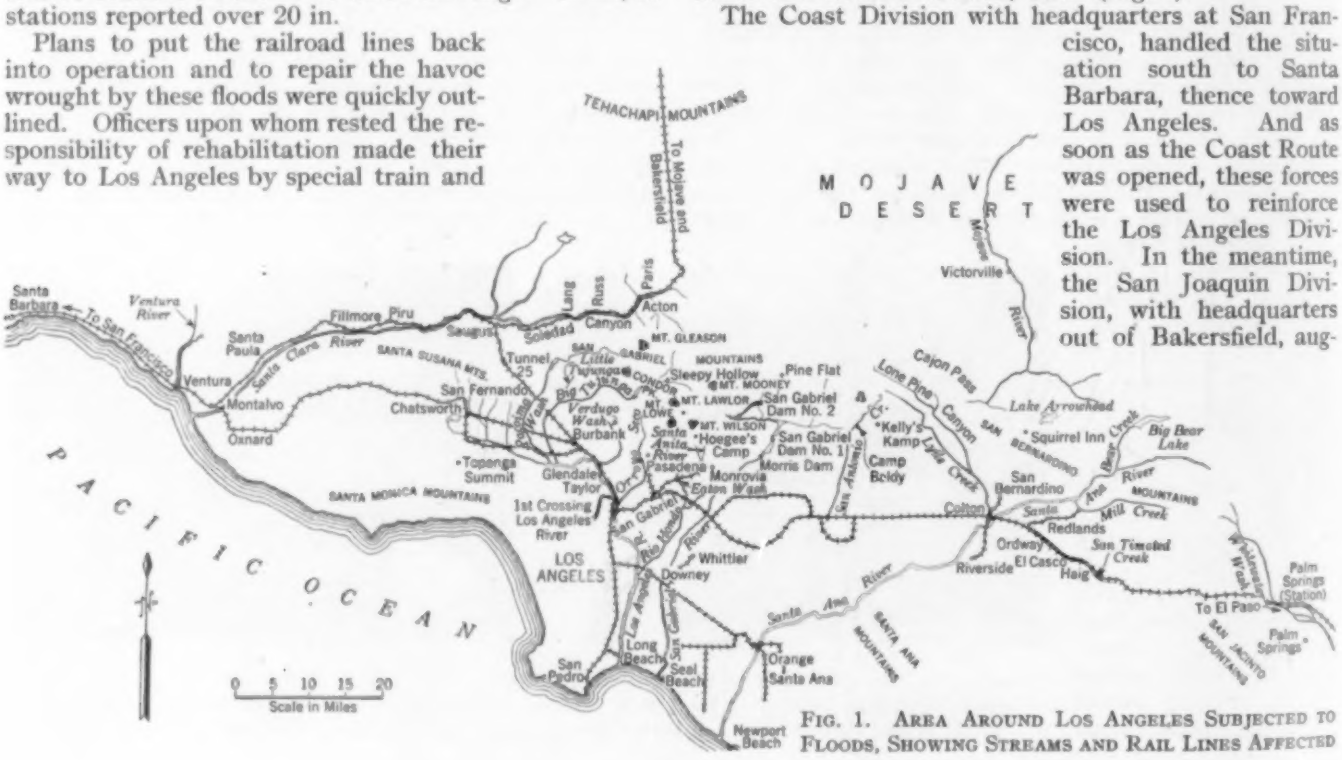


FIG. 1. AREA AROUND LOS ANGELES SUBJECTED TO FLOODS, SHOWING STREAMS AND RAIL LINES AFFECTED

mented by reinforcements from the Western and Sacramento divisions, proceeded to the huge task of building a new railroad in the Soledad Canyon. But before they could make contact with this job there was the problem of clearing away two large slides on the Tehachapi Mountain and correcting other line interruptions of less serious nature.

Purchasing and store departments were organized on a day-and-night basis. Material and supplies were rushed by special trains on call from front-line officers, and drawing on stores at Los Angeles, Bakersfield, Oakland, Tucson, and El Paso. Commercial quarries furnished riprap and ballast.

Contractors with all types of modern grading equipment were engaged to supplement railroad equipment and organization. Trucks were used to convey men, materials, and tools over highways and secondary roads as their availability permitted. By this method work was carried on in many places simultaneously instead of by the slower method of working from both ends toward a center. To illustrate the versatility of such an attack—in order to reach the central portion of the damaged area between Lang and Russ in the Soledad Canyon (Fig. 2), a washed-out bridge on a county road had to be replaced by a pipe culvert and fill. The route involved a 23-mile detour by highway between two points only three miles apart by rail. Over this road was transported contractors' equipment, commissary supplies, men, tools, rail, ties, pipe culverts, and even track-laying machines. Also at Colton, 57 miles east of Los Angeles, all material for a 650-ft trestle, having been fabricated at a Los Angeles mill, was transported over highway by truck and erected by bridge forces similarly transported.

One of the most spectacular catastrophes was at the First Crossing of the Los Angeles River in the city at Dayton Avenue. A pier supporting double-track steel girders was undermined and washed out; the falling girders deflected the current against secondary main tracks on the opposite (east) side of the river, resulting in these tracks also going out. Thus all access to Los Angeles from the north was severed; but further, the large Taylor freight yard was cut off from other railroad facilities, industrial Los Angeles, and outlying districts. All effort was concentrated on restoring the east-bank lines, which was accomplished in 24 hours by placing a temporary trestle followed up with log crib and fill. Shortly after, a temporary trestle was driven across the first crossing gap, later to be replaced by a temporary steel bridge.

A steel bridge crossing the Santa Clara River, on the Coast Line near the ocean at Montalvo, was saved after a 48-hour fight with flood waters so high as to be up on the girders of the bridge, which was 1,753 ft long and had a normal vertical clearance of over 20 ft from base of rail to stream bed. The current was very swift and splashed waves against the ties. The scouring action exposed the piling upon which the piers rested, causing the piers and girders to sway back and forth. By dint of judicious and careful placing of many carloads of riprap the bridge was saved.

By March 8 the Coast Line to San Francisco, the Sunset Line to the east, and the San Joaquin Valley Line as far south as Mojave, had been opened up. There remained the rehabilitation of the track in the Soledad Canyon before the main-line service via the San Joaquin Valley Line could be resumed. The destruction of the canyon stretch was so complete that an entirely new railroad had to be built. After an exploration on foot it was decided to: (1) hold pile-driving to a minimum; (2) open up in the center and work both ways, which, counting both ends, would give four faces upon which to work; (3) use corrugated pipes and timber boxes in temporary fills in place of trestles at washed-out bridges, to expedite opening of the line, trestles to be driven later as required; (4) utilize modern grading equipment in restoring embankment; and (5) restore a washed-out county road, as already mentioned, to move in equipment and railroad supplies, and thus permit track laying to be carried on at the center as well as the ends. Work was successfully prosecuted as planned and this line restored to service on March 15. As main lines were rehabilitated, forces were transferred to branch lines, and by April 26 the important branches had been restored to service.

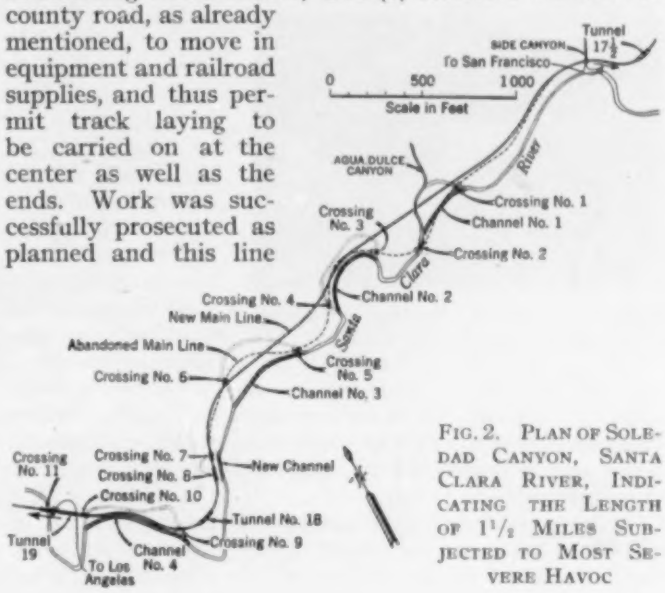


Fig. 2. Plan of Soledad Canyon, Santa Clara River, Indicating the Length of $1^1/_2$ Miles Subjected to Most Severe Havoc

The new and permanent First Crossing of the Los Angeles River consists of two 192-ft 6-in. spans; they are continuous girders resting on abutments and a center pier that will be founded on solid rock. We know that this bridge will never wash out, first, because it is founded on bedrock with steel well above the highest flood water; and second, because it conforms to the alinement and hydraulic grade of the new Los Angeles River being constructed by the U.S. Engineer Corps.

Soledad Flood Largest of Railroad Record

In the Soledad Canyon the problem of permanent construction, for all practical purposes, was solely a railroad matter. The flood of March 2, 1938, struck with such fury and suddenness as to confirm my belief that a cloudburst of unparalleled record broke on the north slope of the San Gabriel Mountains in the general vicinity of Mt. Gleason—a steel bridge gang working on a bridge was not able to save its heavy tools and bridge-erecting equipment. We believe it to be the largest flood of railroad record. Measurements made at several controlling and straight sections of the canyon to determine the high-water cross-section and slope of stream, indicated that the flow ranged from 19,500 to 27,900 cu ft per sec. Several sections indicated a flow of 20,000 cu ft per sec.

The railroad was damaged for a distance of 13 miles. From Russ to Lang, 4 miles, the road was a total loss, with serious side cutting, tracks gutted, ballast washed away, bridges blocked with debris and logs, piers and abutments undermined, girders dropped into the stream bed and buried, and tunnels filled with logs and debris.

By reference to Fig. 2 it will be noted that the Santa Clara River follows a tortuous course, requiring 11 bridge crossings in a distance of 1.8 miles. Two of these bridges, crossings Nos. 7 and 8, were being eliminated by a short channel change; of the remaining 9

only 4 were left on their foundations and 3 of these were buried in sand and under log debris; the fourth was left high and dry because the river had washed out and was occupying 1,100 ft of approach fill.

Engineering studies led to the decision to construct a new railroad on a much higher grade, with better alinement, and to eliminate all but one of the river crossings. The magnitude of the channel changes is illustrated by the fact that the yardage involved was much larger than that for the railroad grading. With the shortened channel we got the effect of steeper grade, smaller cross section to handle the flood flow, greater tendency to scour but lessened silting, economy of construction, and elimination of log jams.

SPILLWAY DAM TO CONTROL EROSION, CACHE CREEK, NEAR CAMERON—DOWNSTREAM FACE

Although providing for twice the measured flood of 20,000 cu ft per sec, we were successful in securing a line that eliminated all bridges except the eleventh crossing. At that point an additional span opening was installed and the new pier and abutment upon which it rested were founded on rail-steel piles with concrete well below the scour line. The approach embankment was well protected from side wash by special concrete bank revetment, using second-hand rails driven deeply into the gravels, reinforced with heavy galvanized netting.

Throughout this stretch the alinement was improved with flatter curves, reduced total curvature, and better grades. These changes combined to give a subgrade ranging from 18 to 24 ft above stream bed, except at the old seventh and eighth crossings, where the depth was 13 ft, being governed by an existing tunnel which controlled grade and alinement. At this point a retaining wall was constructed with its top higher than the top of rail and the channel was made extra wide. Elsewhere, if bank protection was needed, the slopes were covered with concrete slope pavement.

Other problems were worked out, departing somewhat from conventional standards. For instance, a tunnel was constructed in an open cut to pass the county highway over the track, and Agua Dulce Creek was passed under the railroad through a tunnel. The efficiency of the water tunnel was increased by enlarging and tapering the upper end and installing a rail grillage to catch floating trees and brush.

Provision should be made for debris removal from impounding basins. Such a system was installed in correcting the condition that developed at the westerly end of Tunnel 25 (Fig. 1), known as the San Fernando Tunnel. As originally constructed (1874) the ravine containing the west approach cut and portal was bypassed around the cut by a storm ditch. The storm caused a large flow of water, heavily surcharged with sediment, to more than fill the ditch so that the entire stream flowed into the railroad cut, filling it with sand to a maximum depth of 15 ft, the water and slickens extending out both ways along the track and into the tunnel.

As corrective measures, a debris basin was provided above the tunnel portal, with a channel of adequate capacity along the track replacing the old ditch; and a secondary basin was built at the lower end with a concrete spillway leading to the creek's culvert opening. The upper basin will catch the coarser flow of detrital material, the lower basin the sediments, releasing water sufficiently clear to keep the culvert scoured. It is expected that the channel below the track, which has been filling up, will begin to lower, thus removing the years' accretion of debris by mechanical methods.

SOLVING PROBLEMS CAUSED BY SOIL EROSION

Cache Creek on the easterly slope of the Tehachapi Mountain presented a problem involving soil erosion. A deep arroyo had formed through a tableland adjacent to and above the track. To stop the cut-back action, two spillway dams were constructed across the arroyo.

The spillway structure is essentially an earth dam faced with grouted rock through which is placed a corrugated pipe, the upper end being near the top of the dam and the lower end at the lower toe. To guarantee the functioning of the structure during floods that possibly might be greater than the pipe capacity, an overflow weir of paved rock is provided above the top of the pipe. Such structures impound sediments and prevent cut-back action from extending upstream; the number required of course depends on the steepness of grade and the extent of the arroyo or wash.

San Timoteo Creek on the main line eastward is an example of extended erosion or "cut-back action." The alluvial soil and sand through which the stream meanders will not support the velocity of flow without erosion. This has resulted in forming a deep arroyo with vertical banks constantly becoming deeper and extending in length.

Several types of design have been used: (1) paved riprap slopes for drops of about 6 to 8 ft in height—with a rail barrier at the lower toe to retain the riprap and prevent undercutting; and (2) concrete apron drops for heights of 14 to 20 ft. The design has varied in detail depending on the locality and our experience, but we have about standardized it according to the following specifications: (1) a rectangular weir 40 ft wide and 8 ft deep; (2) wing walls and upper end of weir to rest on steel interlocking piling; (3) the toe to rest on wood piling with some arch effect to distribute some of the thrust to the sides; (4) the slope of the apron to be of the ratio 21 horizontal to 12 vertical; (5) approach fills of selected earth and gravel from adjacent hills; and (6) dams so spaced as to stabilize stream bed on gradients of 0.8 to 1 per cent.

The intent of this paper has been to direct attention to some of the more important problems created by this flood. I realize the uncertainty attached to any definite conclusions for general application, but I am confirmed—at least for my own guidance—in the opinion that within the states of California, Arizona, New Mexico, and Texas the bridge and culvert openings should be designed for the flash rather than the sustained runoffs; that much opportunity exists to improve the hydraulic carrying characteristics of structures, both existing and future; and that more adequate protection of embankments at and adjacent to openings is necessary and can be economically provided. Further I venture to suggest that, notwithstanding the benefits to be obtained from systems of retards and impounding dams, after all, such structures are temporary expedients in arresting the flow of mountain-eroded material—the ultimate destination of which is the sea—and engineers should challenge the operation of this natural law by annually removing impounded debris and replacing it in the valleys and on the mountain slopes whence it came.

Metropolitan Highway Problems

To Achieve Results, Engineers Must Help the Public Understand the Self-Liquidating Possibilities of Costly Improvements

By L. I. Hewes

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IN future, says Dr. Hewes, the highway engineer may play a less subordinate part in city planning than he has in the past. Accident records, increasing congestion, and the deterioration of downtown property values are today making the public realize the need for a truly adequate solution to the problems of metropolitan highway traffic. Dr. Hewes discusses here a number of these problems—mass transportation, the handling of through traffic, parking facilities, and so forth—with particular emphasis on the financial aspects. The article is an abridgment of a paper before the City Planning and Highway Divisions at the 1939 Annual Convention.

IF engineers had foreseen fifteen years ago the degree to which metropolitan highway traffic would become a problem, it probably would have been extremely difficult to arouse public effort to put into effect any adequate plan for its solution. But today in the public mind the urgent need for reducing accidents on the highways and within cities has become a motivating force for such action; another force has been awakened by the increasing recognition of the loss of time, energy, and convenience to the vehicle user, caused by congestion; and finally there is the slowly developing realization that the investment in the improved motor vehicle itself is being defeated or lost under present conditions. A number of associated phenomena, less visible but highly significant in relation to metropolitan traffic, are also making themselves felt—such as the gradual deterioration of downtown property values. Today, therefore, the time is ripe for a major attack on metropolitan highway problems.

The solving of these problems undoubtedly has a money value for the public. We hear about self-liquidating projects, and there are notable examples of direct changes that liquidate construction costs. (The prototype of these is the Columbia River toll bridge between Portland and Vancouver.) Projects also sometimes demonstrate indirect relationships between convenience, comfort, time saving, and dollar value.

SELF-LIQUIDATING ASPECTS NOT ALWAYS OBVIOUS

For the improvement of metropolitan traffic conditions, the financial problem is not simple. Yet in the basic characteristics of city traffic there are possible elements of its solution. Obviously, city sewage systems are not directly self-liquidating. They are necessary, however, for convenience and health. They become self-liquidating only by mutual agreement made real by taxation. Metropolitan water supplies are more visibly self-liquidating. To finance the solution of the metropolitan highway traffic problem it is going to be necessary for engineers to help the public understand less visible self-liquidating aspects of very costly improvements.

Recently I ventured to pass on some relationships derived from traffic conditions in Los Angeles. In that metropolitan area there probably are a million motorists. It has been estimated that the average cost of owning and operating a car there is $500 yearly. Ten per cent of that cost would amount to $50,000,000, and that percentage doubtless actually could be saved by adequately improved traffic facilities. Some of such annual savings, however, would not immediately reach a visible dollar stage. In general they would be almost insensible. Elimination of the wear on cars and of increased cost of gas alone at unnecessary stops of course would be a real and eventually a visible saving. Attempts previously have been made also to evaluate the time saved the driver and passengers. Unquestionably such savings would run into very large amounts. Calculations of this sort, however, must be made with care.

In cities, in contrast to rural sections, we find mass transportation and pedestrian movement. The two are somewhat related. Mass transportation distributes pedestrians and requires stops for loading and unloading them, so that it needs safety zones as well as minimum interference with motor traffic. Previous studies show that pedestrian movement as a whole is so important, and its accident rate so high, that its protection is paramount. At crossings pedestrians interfere with motor traffic, but at the same time they themselves are greatly interfered with or dangerously delayed by left or right-turning traffic. The pedestrian accident rate is especially high in the outskirts of cities where lights are poor, vehicle speeds high, and sidewalks absent. In some cities it is increasing. Indirectly also the pedestrian and the mass-transportation passenger are important elements of future motor traffic. By street car or bus, 35 to 50 people per unit are transported, whereas from 1.50 to 1.8 are carried by automobile. With the existing street facilities, unless mass transportation with its adjoined pedestrian movement can be improved and increased, motor vehicle transporta-

Photo by U. S. Public Roads Administration

The Henry Hudson Parkway in New York City—One Unit in a System of Express Highways That Carries Through Traffic, Non-Stop, from the Battery to Westchester County

Photo by U. S. Public Roads Administration

GENERAL FEATURES OF DESIRABLE DESIGN FOR A DEPRESSED EXPRESS HIGHWAY IN A CITY

tion of people will tend so to increase that it will eventually stifle itself.

In some cities there is already a definite decline of mass transportation. With overcrowded street cars crawling through cities, increase of more attractive transportation by private car is an inevitable trend although it is much more expensive.

Any study of metropolitan highway problems, therefore, must include analysis of the pedestrian movement and its relation to mass transportation. It must recognize that the worker's time between home and job is a most serious item. It must recognize the importance of the analysis of pedestrian accident records by trained men.

To serve adequately, mass transportation units must approach the composite motor vehicle in pickup, braking capacity, and speed. In this respect, the best modern street car holds its own, and of course busses on rubber tires can do likewise. Mass transportation is a great decentralizing agency that should move unobstructed by traffic lights, and if by bus it must have clear curb space to load and discharge.

Another characteristic of metropolitan traffic largely absent on rural highways is parking. Although obviously streets are primarily for traffic movement, street parking still is a moot question. Parking along the curbs obviously cuts off two driving lanes for most streets. Not only is most expensive space occupied, but the movement in and out of parking positions restricts traffic and is a hazard. On the other hand, it is recognized that there must be curb access to places of business but still with an insured turnover of curb space, particularly at peak traffic hours. Designed parking space directly adjacent to busy thoroughfares introduces a hazard and interruption to through movement of motor traffic by entering and leaving vehicles. Engineers, however, cannot continue to back away from this parking problem. Private initiative is introducing parking lots at bad locations. Private investment in covered parking is ominously increasing at undesirable places. Tax-delinquent buildings are being destroyed in the heart of the city to make indiscriminate parking lots. The possibilities of curb parking meters need further study.

There is considerable evidence that around-the-corner or off-main-street parking is a possible partial solution in some cases. Since parking in the Chicago Loop was prohibited, there are less accidents and faster traffic movement. Certainly many new commercial enterprises should not continue to be predicated on the continuation of curb parking privileges. The provision by some industries for employee and customer parking, particularly at decentralized points, is gratifying and significant. The solution of parking problems will not be easy. It may involve condemnation of suitably located old buildings in the retail district; it may involve meters with overtime penalty; it may involve better distributing systems, but it is certain that lack of a solution will condition the preservation of downtown property values and will also condition the areas of shopping districts.

The Public Roads Administration lately has become increasingly interested in metropolitan highway problems, and fundamental facts about metropolitan traffic are found in the Administration's recent report to Congress ("Toll Roads and Free Roads," House Document No. 272, 76th Congress, First Session). This report is based largely on the Highway Planning Surveys made in 46 states and on some allied studies by the Administration. Some new viewpoints here are developed, especially with respect to measure of traffic congestion, the analysis of traffic entering cities, and the financial problem of right of way. Those new viewpoints should bring about an advance in our thinking.

STUDIES OF TRAFFIC-CARRYING CAPACITY

With reference to congestion, there occurs the question of the traffic-carrying capacity of a single traffic lane at various average speeds and vehicle spacings. Older estimates and formulas tended to give values that are too high. The Administration studies indicate that speed differences are a key to the measurement of volume and of congestion. On an absolutely free road, every driver could choose his own speed. As more traffic occurs, the range of speed differences is reduced until a point is reached where practically all vehicles travel at the same speed. Then arises the question of the correlated spacing and actual speed at which corresponding numbers of vehicles in the average type of traffic, say on a two-lane tangent, will travel. These variables determine volume. In a large sampling a theoretical maximum volume in one lane was found at 33 miles per hour, but the calculated volume did not vary over 20 per cent for speeds between 20 and 50 miles per hour. It ranged theoretically between, say, 1,900 and 2,150 vehicles per hour. This calculated volume at constant speed is not realized in actual traffic operation.

These studies, made primarily for rural highways, have some significance also for metropolitan conditions. As speed differences decrease, metropolitan traffic density increases. Downward changes in speed differences reflect conditions of interference. There is no critical point (density or volume) at which sudden

changes in any of the variables occur, but rather a gradual change. Individual roads exhibit varying characteristics.

Thus, at speeds of from 23 to 25 miles per hour, the Administration found a total maximum hourly capacity on two different two-lane roads indicated to be 1,880 vehicles and 2,200 vehicles, respectively. In both these cases, speed differences practically disappeared. Similarly, on a four-lane undivided rural highway, a total capacity of 4,150 vehicles at 22 miles an hour, and 8,600 vehicles at 11 miles per hour, is reported. But on divided highways capacity is increased. Thus on one four-lane divided highway the indicated maximum capacity was 5,400 at 15 miles per hour and 7,300 at 40 miles per hour. In a sense, however, a new phase always is reached when all vehicles are traveling at the same speed. This ultimate speed phase is somewhat variable from road to road. On a two-lane tangent a uniform speed condition, however, seemed to be correlated with 1,980 vehicles per hour with all travel in one direction, or similarly correlated with 1,100 in each direction. Corresponding speeds were 23 to 25 miles.

Under urban conditions, with interferences eliminated, Lewis W. McIntyre, M. Am. Soc. C.E., reported from 2,000 to 2,500 passenger automobiles as the one-lane congested capacity at intersections with speeds from 11 to 15 miles per hour (PROCEEDINGS, Am. Soc. C.E., November 1937). The Administration studies that indicate, at 11-mile speeds on four-lane undivided highways, the possibility of a traffic volume of 8,600 vehicles on the open road thus give rather an illuminating check on McIntyre's results. The figures indicate essentially that by freeing metropolitan routes from all interference, a great increase in capacity and speed of movement occurs.

The elements of impedance or interference in the metropolitan traffic stream include first of all, of course, cross-street traffic and associated left-hand turns, and to some extent right-hand turns. Then come the problems of vehicles entering and leaving garages and parking spaces, and of the curb-parking practice which usually eliminates two lanes of city pavement for operating use. Frequently there is in city streets some unnecessary overload of through traffic destined beyond the city outskirts, which contributes in varying amounts to the impedance of strictly metropolitan arteries. The lack of divided highways in many cities also tends to reduce freedom of movement. And of course there are other interferences in cities, such as pedestrian crossings, passengers stepping on and off street cars and busses, and deficient cycles in "Stop" and "Go" lights. The result is that instead of theoretical capacities of anything like 2,000 vehicles per hour per traffic lane, we often are confronted with capacities of, say, from 200 to 500 vehicles per hour per lane.

Some other important major characteristics of metropolitan highway traffic, set out in the second part of the recent Administration report to Congress, have been disclosed by the state-wide Highway Planning Surveys. It is sufficiently evident from traffic maps that a great increase in traffic volume on rural highways occurs at the approach to cities. The design capacity of these metropolitan zone highways, however, is not found to be correspondingly increased, largely because of the great difficulty in acquiring right of way. Within the cities themselves, only partial relief is afforded by the dispersing of traffic. A trunk-line street, frequently carrying a U.S. number, often is a preferred route for through traffic into the city and beyond. Traffic tends to increase within the city toward the center and will go toward the center unless otherwise directed. Bypass routes or combination beltline-bypass routes in cities would eliminate a varying fraction of the through traffic on main metropolitan arteries. Bypassable traffic, however, in larger cities is not so large as frequently has been assumed. The traffic on the Washington-Baltimore road, for instance, is mainly traffic between the respective city centers. At Washington, traffic going south beyond the city is only 2,269 vehicles out of 20,500. At Baltimore, only 2,670 vehicles are bypassable out of a total of 18,900. The remaining traffic largely penetrates to the heart of those two cities.

NECESSITY FOR HEAVY-TRAFFIC ROUTES THROUGH CITIES

The report states: "The only course that promises a really satisfactory solution is the provision of adequate facilities for conduct of the heavier entering traffic streams through the city at or near its center, and on to appropriate exit points. . . . In the larger cities generally only a major operation will suffice—nothing less than the creation of a depressed or an elevated artery (the former usually to be preferred) that will convey the massed movement pressing into, and through, the heart of the city, under or over the local cross streets, without interruption by their conflicting traffic." Even in cases of shuttle traffic without much addition from rural highways, the same solution is needed, for within the city the traffic is similar. In many cities, the difficulties of such major improvements have been viewed as unsurmountable, but there are notable exceptions. Among them are the West Side Highway and the Henry Hudson Parkway in New York, and connections; the Merritt Parkway in Connecticut; sections of depressed highway in St. Louis; the Roosevelt Boulevard in Philadelphia; the San Francisco–Oakland Bay Bridge; and, among the earliest of all, the Wacker Drive in Chicago.

Pending other undertakings of the magnitude of the examples cited, helpful aids to metropolitan highway traffic problems have been suggested. They include marked detours that are actually convenient for through or bypass traffic and that afford comfortable passage without congestion; also the use of one-way streets, carefully selected; more vigilant police patrol of double parking; more careful adjustment of the crossing light cycles, and so forth.

A considerable fraction of the metropolitan traffic problem is due to the daily movement of suburban dwellers to and from work. These suburbanites have increased with the growth of the cities and with increased use of the private automobile. The recent growth of the suburbs has not been, however, entirely "new" growth.

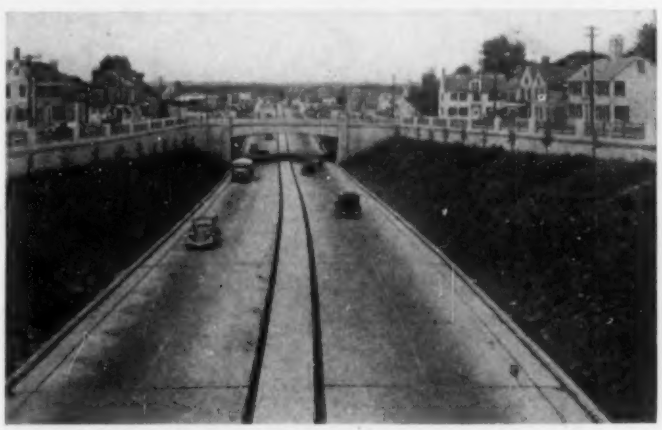

Photo by Massachusetts State Highway Department

HIGH STREET GRADE SEPARATION IN NEWBURYPORT, MASS.

Part of it is the result of an outflow of city residents. In this connection, the studies of those interested in city planning reveal an inner city deterioration or blight which is rather definite in pattern from city to city. Within a bounded area that usually contains the active business center in a city where there has been a loss of city population, there also is a band or zone of slowly progressing decay. The Administration report discusses in considerable detail the situation presented by the city of Baltimore, pointing out that the former homes fringing the business district have descended by stages to lower and lower income groups, and that some of them have now run the entire gamut to the slum level. "Each year a few of them make way for parking lots. . . . each year the city 'takes over' a few of them for unpaid taxes. And now—the federal government is beginning to acquire them in batches in connection with its slum clearance projects. . . one of the reasons for avoidance of delay in dealing with the problem of trans-city highway connections and express highways. . . . There is growing danger that these new properties, sporadically arising, and the more compact developments by the government in its slum clearance projects, will block the logical projection of the needed new arteries into the city center. . . . Another important reason in the planning of new trans-city arteries and express highways is that in the business district itself in most cities, but particularly in the older ones, there is a slow decay that will not be arrested until there is radical revision of the city plan, with greater space for unfettered circulation of traffic to permit a reintegration of facilities for the various forms of transportation."

Photo by Rhode Island State Highway Department

AN ARTERIAL DEVELOPMENT CUT THROUGH A THICKLY SETTLED AREA—FOX POINT BOULEVARD, IN PROVIDENCE, R.I.

FEDERAL AID IN RIGHT-OF-WAY PURCHASE SUGGESTED

The commissioner of the Public Roads Administration, Thomas H. MacDonald, some time ago pointed out that heavy right-of-way costs could not continue to be met from current revenue. This fact becomes more clear with study, notwithstanding the large operating revenue from motor traffic. In 1938, the user taxes totaled $1,177,010,000, of which, however, about 13 per cent was diverted to non-highway purposes. The balance is distributed to state highways, local highways, and city streets. For these purposes, it is constantly stretched over a greater mileage. It cannot be used for expensive right-of-way features for new metropolitan express highways without greatly distorting all reasonable programs and future requirements.

Consequently, the recent Administration report suggests that the federal government contribute to the needed metropolitan improvements by facilitating the acquisition of adequate rights of way by supplying capital for investment for such rights on a sufficient scale. It suggests that the government act on the requests of the state highway departments under the state and federal laws, and that any acquired rights of way remain the property of the United States subject to lease by the states over a period of 50 years under terms that would amortize the initial cost. Such action, the report states, would require federal authority, probably with corporate status able to issue obligations. However, such federal authority would not be effective in states that did not have constitutional authority to acquire land in sufficient amount for anticipated future developments.

In connection with the acquisition of rights of way, there arises the question of extending widths sufficient for full control and possibly even further to extend land and border control by resale for restricted purposes. Such practice of excess takings for road or street purposes and subsequent resale that brings recoupment has been successful in England and elsewhere, but is questioned by our courts unless the whole procedure is by agreement with the original owner. Another troublesome question in connection with express highways is the right to deny access without consent of the abutting owner. Such right even on highways through new rights of way is questioned; so in general it is a matter in which fundamental state action may be needed—like that already taken in Rhode Island and California.

That there are tangible public benefits obtainable through the acquisition of wide rights of way for metropolitan express highways is doubtless true. If wide beltline highways through blighted areas, for example, stop the blights, recession of taxable values in close-in city areas may be arrested. Certainly the realtor cannot stop such recession, which is now increasing in many cities.

The engineer increasingly must concern himself with these long-range problems, particularly with the sound financing of public works. Self-liquidation sometimes is easy to establish (or deny), but it is more difficult to translate intangible, but nevertheless real and important, benefits into dollar values. We highway engineers must from now on inform ourselves carefully about the fundamentals of the financial structure for our highway and street development and for their upkeep as a whole. We must be able to deal intelligently with pressure groups.

It was highway engineers who instigated and are continuing the state-wide, nation-wide Highway Planning Surveys which began in 1936. These surveys are proving daily to be of fundamental importance. Never before has there been sufficient information available to deal conclusively on a nation-wide scale with highway transportation problems. This report will be kept current. It already shows us how the metropolitan highway problem is related to the rural highway problem. It may be that in the future the highway engineer will play a less subordinate part in metropolitan planning—to an extent he now has an opportunity to become a helpful city planner.

Professional Status—A British Viewpoint

Maintenance of Technical and Ethical Standards the Most Important Factor

By Clement D. M. Hindley

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Improvement of technical qualifications, a rigid adherence to ethical standards, and a conservative long-term policy of publicity, are the activities best calculated to improve the social and economic status of the engineer, in the opinion of Sir Clement Hindley. Although conditions controlling the program and attitude of the Institution of Civil Engineers differ in many respects from those in the United States, engineers here may nevertheless study with profit this presentation of the British viewpoint. The paper was prepared on special invitation of the Society's Committee on Professional Objectives.

In order to examine this subject of the social and economic status of the members of the civil engineering profession, it is useful to consider generally the conditions which in a democratic country influence or determine the social and economic status of any profession or calling. It would seem to be axiomatic that status depends fundamentally on the technical and ethical standards maintained. Even with the most rigid protection of law or tradition, a profession cannot improve or even maintain its status if it does not make itself worthy of public confidence and of proper remuneration by giving efficient and disinterested service.

It is even possible to argue with some historical support that a profession which by artificial means is given a monopoly of certain activities and is consequently relieved from economic pressure, is liable to allow its standards to deteriorate. But at this stage it is sufficient to recognize that status is dependent on maintenance of high standards.

As secondary influences on status may be noted (*a*) legislative or statutory protection and (*b*) traditional public recognition and respect for the degree-giving or diploma-giving body. The former may consist of legal prohibitions against activities of a certain kind being exercised by persons not specifically qualified under prescribed standards. Or again there may be legal restrictions on the use of designations or professional appellations. And lastly there may be certain privileges granted by law to the members of a calling in return for services which may be demanded by the state. The influence on status derived from (*b*), traditional public recognition and respect for the authority granting diplomas, depends on historical factors which vary considerably in different countries, and is possibly of more importance in Great Britain than elsewhere, but it should be noted that the continued value to the profession of this recognition is largely dependent on the standards maintained, and this influence is consequently to be regarded as secondary in importance to that maintenance of standards.

There is a third category of influence which includes the efforts made by the profession to inform the public of its acquirements and achievements, whether these are in the form of propaganda or rely merely on a tacit appeal by obvious success in achievement.

In regard to propaganda it is necessary to observe that in most professions active propaganda undertaken by an individual for his own benefit is rightly regarded as unethical, and in fact it is this self-imposed restriction that differentiates a profession fundamentally from other callings. But from the ethical standpoint there need be no such restriction on the activities of the central authority of the profession and in fact it may well feel under some obligation to the public to promulgate in the press or through its own publications information as to the value of its profession to the general community, records of advancement in knowledge and practice, and descriptions of its achievements in service to the public.

Before concluding this general review of the conditions which influence professional status, it may be well to glance at the measures which have been adopted effectively, mostly by callings not of a professional nature, to improve social and economic status. Among these are: (*a*) restriction of number of new entrants, (*b*) refusal to collaborate with non-members, (*c*) collective bargaining in regard to remuneration and conditions of work, and (*d*) political influence through voting power. These measures will be referred to later in relation to the specific case of the civil engineering profession.

HOW THE PROFESSION DEVELOPED IN GREAT BRITAIN

In the meantime a word should be said regarding the development of civil engineering as a profession in Great Britain. At the commencement of the nineteenth century the professions generally recognized as such were limited to the church, the services—that is, the army and navy—and the law. Engineering as a profession was unknown in civil life, although military engineering had long been recognized as a professional activity and military engineers were sometimes entrusted with the construction of roads and bridges. For some centuries engineering works of public utility had been carried out by men, often of humble origin, who had instinctive ability in the construction of such works. Examples may be found in the draining of the Fens by Vermuyden, the supply of water to London by Myddelton, canals by Brindley, and at a later date harbors and maritime works by Smeaton. These men conceived the works, designed them broadly, and carried them out by means of direct labor such as the millwright, the blacksmith, the mason, the quarryman, and gangs of laborers under gangers.

The contractor as we know him today, carrying out the work to the design and under the supervision of the engineer, only made his appearance in the early part of the nineteenth century. It was in fact Thomas Telford, the first president of our Institution, and regarded by many as the founder of our profession, who was largely responsible for developing the system of carrying out public works by contract. Many of the conditions embodied in modern contracts owe their origin to him.

This separation of the two functions—that of design and supervision and that of execution—gave an important stimulus to the acquisition of scientific and

practical knowledge by the engineer, who had to fit himself to direct the efforts of the contractor. Further, it contained the germ of the idea underlying modern professional ethics that the engineer is remunerated by fees and the contractor by profits.

The growth of engineering as a profession owed most of its progress to the fact that in 1820 a group of young engineers, who had two years before formed a society called The Institution of Civil Engineers, invited Telford to become their first president, a position which he occupied for 14 years. With the collaboration of others, whose names are remembered with honor, Telford succeeded in laying the foundations of our profession, and in the royal charter, granted in 1828, can be found precepts which throughout the past century have guided the policy and the activities of our Institution.

It is worthy of note that the cardinal principle of this charter is that the Institution is set up for the advancement of mechanical science. That indeed is the main or sole object with which the body corporate is entitled to act and all other things are subservient to it. The whole of the resources of the Institution are to be used for this function—it is forbidden to use them for the benefit or profit of any individual member. It is out of this fundamental principle that the whole scheme of the Institution as we know it today has been built up. The Council, the governing body, elected by the members, sets up standards for admission, regulates the training of students who aspire to be members, prescribes standards of ethical conduct, provides facilities for reading, discussion, and publication of papers, and finally, uses the resources of the Institution in promoting scientific research.

PRACTICAL AS WELL AS TECHNICAL TRAINING STRESSED

In regard to technical standards the Institution has been perhaps the pioneer of the principle that an engineer cannot be made by book learning alone. Telford himself spoke and wrote in forcible terms of the impossibility of reaching proficiency without practical experience. But the need for education both general and scientific became more recognized as the growth of industry produced more and more complex problems to be solved. In the last decade of the century engineering courses were already established in some of the universities and it was at this time, in 1896, that the Institution formulated its own standards of scientific knowledge by introducing examinations for the admission of students and new members.

These examinations from the first were of a standard equal to the highest aimed at in the universities, and they have progressively been raised. But the Institution avoided the error of becoming merely a degree-giving or diploma-granting body, like a university, by insisting on a period of practical training being added to the attainment of the prescribed educational standard before admitting a candidate for election to membership.

The prescribed qualifications both of education and training have always been jealously administered without fear or favor, and it is claimed that this has been a powerful factor, if not indeed the primary factor, in improving professional status. At the present time the qualifications inherent in corporate membership in the Institution are recognized universally as credentials of the highest order both in technical ability and in professional or ethical standards, and in the opinion of many this provides a status which could not have been reached had the devotion of the leaders of the profession to the precepts of the charter been less tenacious or less conscientious.

The significance of the grant of a royal charter lies in the fact that recognition of the highest authority in this country has been given, firstly, to the need in the public interest for a body corporate to advance a particular object, and secondly, to the competence of the body of men on whom the charter is conferred to carry out that object. A charter is only obtained after an exhaustive inquiry has been made into these two considerations by the Privy Council, and once it is granted, the body corporate is left free to carry on its duties without interference so long as it complies with the terms of the charter. The penalties for action contrary to those terms is no less than forfeiture of the charter.

It was the intention of those who framed the objects to be included in the Institution's charter that the activities of the body should cover the whole field of engineering science. For this reason there has been a successive broadening of the qualifications required for membership and the roll for many years past has included, besides civil engineering in the restricted sense, engineers of many other branches such as mechanical, electrical, marine and naval, mining, gas, and structural engineering. But although for nearly a century the Institution was the only chartered body of engineers in this country, other more specialized bodies of engineers grew up alongside it and eventually succeeded in obtaining charters of their own.

It is a matter for argument, now largely of an academic nature, whether the engineering profession would have obtained higher status and more public recognition if these schisms in the body of engineers had not taken place. It has been argued, for instance, that certain other professions who have such unity have been able to exercise more influence on public opinion and on governmental action by reason of such unity and that thereby they have been able indirectly to improve their professional status. The idea has some attraction and has been revived on many occasions when the position of the profession has seemed to be in jeopardy, or when economic conditions have resulted in inadequate remuneration for the rank and file.

EFFORTS TO SECURE PROFESSIONAL UNITY

Efforts to secure unity have been many and various. The possibility of federation has been explored only to be rejected primarily because of the diversity of standards, and secondly because of the natural loyalty of the members of different branches to the traditions and interests set up by their several institutions. The most notable of these efforts was perhaps the setting up of the Engineering Joint Council soon after the World War, having as its founder members the Institutions of Civil, Mechanical, and Electrical Engineers and the Institution of Naval Architects. This body has been a useful medium for debating matters of common interest between the institutions. For instance, it has been the medium for carrying out the desire of the institutions to establish a common standard of entrance to the profession by students. From this year eight institutions have cooperated in setting up a Joint Engineering Examination Board to control the examinations for a common preliminary examination as a test of general education.

In other directions this idea of lateral lines of cooperation has been developed. For instance, the Research Committee of the Institution has set up many committees for research into special subjects which contain representatives of other institutions. It has also participated in a similar way in research work initiated by other institutions. A further example of cooperation

has been the establishment in 1937 of an Engineering Public Relations Committee, on which 14 institutions are represented and which has been responsible for a widespread expansion of the means of giving the public and the press information about the work of engineers in furthering engineering science.

All these cooperative efforts have undoubtedly had an influence on the status achieved by the profession, and while it is difficult to envisage any closer corporate union between the various branches, it is clear that advances in cooperation must tend towards a better appreciation by the public of the value to the community of the work of engineers.

ETHICAL STANDARDS FOR INSTITUTION MEMBERS

It is necessary now to refer briefly to the standards of ethical or professional conduct laid down by the Institution for its members. In its earlier form the rules of professional conduct were designed primarily to determine the relations between a professional engineer acting as a consultant and his client. The principles underlying these rules were that the engineer was to act in a fiduciary capacity towards his client, was to accept fees as his only remuneration, was to keep clear of any entanglements such as might influence or be held to influence his professional judgment, and was not to solicit professional practice. For many years these were the only rules laid down for the guidance of engineers. They were in many respects inappropriate to the work which many members of the Institution found available to them. For instance, the prohibition of advertising could not be properly applied to contractors or manufacturers, and payment by fees only was inappropriate to many other activities engaged in by members of the Institution properly qualified by all the prescribed standards. It was obviously detrimental to retain a code which could not be universally enforced. The code has accordingly been revised and extended in recent years and is thought to provide a reasonable guide to conduct for engineers in whatever capacity they may be serving. The procedure for dealing with offenses against these rules has been carefully drawn up with legal advice—but it is very seldom indeed that the Council have had to put this procedure into action.

It has been said that from time to time there have been movements to bring about action in the direction of influencing public opinion or the government in the interests of the profession and improving its status. The Council have had to make decisions as to whether such action would fall within the terms of the charter; whether, that is to say, the action could be justified as being directed to the advancement of mechanical science or whether it had a primary motive of benefiting the members of the profession. If this criterion be applied to any of the activities referred to in the sixth paragraph of this paper, it will be seen at once that in the main they are outside the scope of the charter and for this reason the Council have studiously avoided any action on these lines.

At the same time the Council decided to pursue as far as seemed practicable the improvement of the means of giving to the public and the press information as to the work of the profession, advances made in engineering science, and descriptions of works carried out. It aims in fact at a gradual process of education of the public to make them aware of the continual process of development of engineering science and conscious of the benefits they derive in their everyday life from the work of engineers.

There are many, of course, who are not satisfied with this long-term policy of publicity and who urge the need of some more obvious and striking policy to put the engineering profession in a position where it will receive more recognition by the public and by government and other public authorities.

This desire has recently manifested itself in two directions. Firstly, with the recognition that the Institution and other engineering bodies are precluded from taking action on the lines generally called "trade union" lines, there has come into being a body known as the "Engineers Guild" promoted by a group of younger engineers. It is too early in its history to estimate what effect or what influence such a body may have, but it is obvious that it must take a considerable time to develop its activities to a point where it can have any specific effect on status.

The second development is a movement which has secured some support, for the registration of engineers by act of Parliament, on the lines recently adopted by the architectural profession. The question is at present "sub judice" so far as official opinion is concerned, but it may perhaps be permissible to state certain fundamental considerations.

While the practical difficulties which such a change presents have been overcome in the United States and Canada, where registration has been in force for many years, there are conditions prevailing in Great Britain which would involve more serious difficulties in carrying through the necessary legislation.

ARGUMENTS AGAINST REGISTRATION IN ENGLAND

However attractive it may be to persons at present possessing no recognized qualifications to be admitted to a register which would secure public recognition of their right to be called engineers, it is difficult to see what would be gained by those whose position is already secured by the possession of the certificate of membership in a chartered institution such as the Institution of Civil Engineers or other bodies that have been granted a charter. To exchange the right to be called a Chartered Engineer for the right to be called a Registered Engineer would not in itself be a guarantee of improved status. And when it is remembered that however carefully the act might be designed in the matter of prescribing standards of admission to the register, there could be no guarantee that such standards would not be lowered by the board or council or by subsequent legislation, and no guarantee that considerations other than those of technical qualification would not in time gradually influence the board in admitting to the council.

It seems obvious that the power and right to prescribe standards would pass from the present institutions to the proposed registration board or council, and that the institutions would in time lose the position they have acquired so laboriously and carefully by many years of leadership.

The writer is of opinion that no surer means could be found of jeopardizing the social and economic status which has been achieved by the institutions who are guided by their charters than to acquiesce in handing over their standard-making functions to a statutory body.

In the writer's view the activities which have been described, namely, the maintenance and improvement of the standards of technical qualifications and a rigid adherence to the prescribed standards of professional conduct, coupled with cooperation with other engineering bodies in the furtherance of these standards, are the activities best calculated to improve the social and economic status of the engineer in Great Britain.

Aerator at Calaveras Dam

Sanitary Aspects of the San Francisco Water System

Natural and Artificial Agencies for Sanitary Control Discussed

From the Program of the Sanitary Engineering Division at the 1939 Annual Convention

By G. E. Arnold

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The present water supply of San Francisco is a chlorinated surface water augmented by deep wells. For ease of description the sources may be divided into three divisions—Peninsula, Alameda, and Hetch Hetchy.

The Peninsula supply is derived from 36 sq miles of watershed situated on the San Francisco Peninsula a few miles south of the city and tributary to three main storage reservoirs with a combined capacity of 29.5 billion gal.

The Alameda Division sources are the Calaveras Reservoir, Pleasanton Wells, and Sunol Infiltration Galleries. Calaveras Reservoir has a watershed area of 135 sq miles and a storage capacity of 32.8 billion gallons. The Pleasanton Wells are deep wells located in the Livermore Valley. The normal use from them is approximately 2 mgd, but in emergency the production can be greatly increased. Prior to the completion of the Hetch Hetchy project, these wells supplied 16 mgd for several years during a prolonged drought. The Sunol Infiltration Galleries pick up a limited amount of water from Alameda Creek.

Hetch Hetchy water is derived from watersheds in the Sierra Nevada Mountains. Four hundred and fifty-nine square miles of watershed are tributary to Hetch Hetchy Reservoir, which has a capacity of 118 billion gallons impounded at an elevation of 3,800 ft. Seventy-nine square miles of watershed are tributary to Lake Eleanor, which has a capacity of 9 billion gallons at an elevation of 4,600 ft. Water is released to the Tuolumne River from both of these reservoirs and is then diverted from the river into tunnels at the Early Intake Diversion Dam. It next passes through the Moccasin Creek Power House, where it develops 100,000 hp. A portion is then returned to the Tuolumne River and the rest brought through 125 miles of pipes and tunnels to San Francisco.

The impounding reservoirs on the Peninsula serve also as receiving reservoirs for water from the Alameda and Hetch Hetchy sources, and four principal gravity-flow transmission lines lead from them to numerous distributing reservoirs in the city, with a total capacity of 315 million gallons. Most of the latter reservoirs are covered and all but one are concrete lined. There are also a number of steel tanks located throughout the distribution system as storage or balancing reservoirs. Because of the hilly terrain San Francisco is divided into 18 districts from five pressure zones. Water from the distributing reservoirs is pumped to a higher elevation or passed through pressure-reducing valves as required.

The sanitary quality of the various sources may be indicated by chemical, physical, and bacteriological characteristics. From the pollutional aspect all sources are exceptionally good. Habitation on the watersheds is less than one person per square mile. Bacteriological examination of the raw waters from the storage reservoirs indicates 12 to 15 per cent of the 10-cc portions to be positive for coliform organisms. Treated waters run from zero to 1.4 per cent of the portions positive. Federal regulations allow potable waters to show the presence of coliform organisms in 10 per cent of the portions, so the treated waters are well within the federal requirements. Chemically, the water varies widely, depending on the source, rainfall, and runoff characteristics. Hetch Hetchy water is a very soft water, containing almost no mineral matter. The hardness of this supply varies from 5 to 10 ppm, chlorides one part, alkalinity 10 to 15 parts, pH 6.8 to 7.2. Water from the Bay region watershed shows a hardness of 80 to 150 ppm and the water delivered to the consumers in San Francisco, depending upon the mixture with Hetch Hetchy, varies from 60 to 120 ppm. At the present time the water served in the city has a hardness of 96 parts, chlorides 10 parts, alkalinity 76 parts, pH 7.6. Physically, the water is good; turbidities run from zero to 5 ppm, averaging 2 ppm. The water normally is free from objectionable taste or odor, although on occasions troublesome algal and weed growths in the Peninsula reservoirs have occasioned complaint.

Four Agencies Contributing to Sanitary Control

Natural and artificial agencies for sanitary control may be classified under four headings: (1) watershed sanitation, (2) storage, (3) disinfection, and (4) laboratory control.

Watershed Sanitation. The policy of watershed ownership started with the beginning of the Spring Valley system in the early 1860's, and has been continued to the present time, thus leading to limitation of permanent dwellings. Watersheds of the Peninsula are patrolled by rangers and reservoir keepers, of which there are two at each reservoir. The area for the most part is heavily overgrown with trees and brush, and habitation is limited almost entirely to employees of the Water Department. Employees' cottages are equipped with concrete receiving tanks for all sewage and waste material, which is hauled off the watershed for disposal. A few well-traveled roads traverse a portion of the watershed, but there are no camping or picnic grounds, comfort stations, or resorts anywhere on the watershed lands. The property is all fenced and access is by permit only. Picnicking is allowed in only a few places and that by permit and under careful supervision. Camping is not permitted under any circumstances.

One of the Spray Nozzles at Calaveras Aerator

The Calaveras watershed is largely privately owned and is used for stock grazing. The Hetch Hetchy watershed is located in the Yosemite National Park and is uninhabited except for a few months in the summer when camping is allowed in certain areas under the supervision of the National Park Service. The privately owned property on watershed lands is supervised for sanitation by the department, with the cooperation of the several departments of public health.

Storage. Storage acts as a natural agency for self-purification of the water supply, and the San Francisco impounding reservoirs are of sufficient size to give the water a long period of storage before it is served to consumers. Fishing, bathing, boating, and other recreational activities on the reservoirs or marginal lands are entirely prohibited.

Disinfection. For many years the water supplied the consumers was entirely untreated, with a remarkable record of freedom from water-borne disease. Now, however, in line with the modern trend, the entire supply is chlorinated and ammoniated on being withdrawn from the storage reservoirs. In some cases where the water passes through open distributing reservoirs, the supply is chlorinated a second time. Dosages average 0.3 ppm with an ammonia-chlorine ratio of 1 to 5. Chlorine stations are visited, in most cases, twice daily. The operators are trained to make chlorine residual tests, and records of all operations are kept on standard forms. Chlorinating equipment is in duplicate at most of the stations and all equipment is maintained in first-class condition. The department also owns a portable emergency chlorinating unit, which consists of a vacuum-type chlorinating machine and a gasoline engine–operated pump mounted on a trailer, which can be taken to any part of the system for use in disinfecting new construction or for emergency use.

Laboratory Control. A complete laboratory and a staff of water purification engineers exercise control over all water treatment for the system. The laboratory is located at Millbrae on the Peninsula, 15 miles from the city. About 100 samples are analyzed weekly in the laboratory; bacteriological examination, specific electrical conductance, hardness, chlorides, alkalinities, pH, and turbidities are determined on practically all samples. Complete mineral analyses of the sources and reservoirs are run every three months. The laboratory examines plankton samples from each of the reservoirs twice each week and supervises copper sulfate treatment to control algal growths. Copper sulfate treatments are made on an average of three times a year. The dosage approximates 1 lb of copper sulfate per million gallons of water, based on the entire contents of the reservoir. A new method of application has been developed by this department, the chemical being applied by sprays that distribute it in solution over the surface of the reservoir. Very satisfactory results have been obtained with this new method. The laboratory also conducts much experimental work and devotes a good deal of time to the study of special problems, which arise from time to time, in connection with the treatment of the water supply.

In 1935, an aerator and screening plant of distinctive design was constructed just below Calaveras Dam to treat the water withdrawn from this reservoir. The aerator consists of a concrete basin in which are located distributing pipes and spray nozzles. The nozzles are of an unusual design, consisting of a 2-in. vertical pipe to which is welded a plate bent at a 45-deg angle, a few inches above the end of the pipe. The water strikes this plate and is broken into a fan-shaped spray, which gives intimate contact between water and air.

As a result of an abnormal series of dry years just before the completion of the Hetch Hetchy system, the water in the Peninsula reservoirs reached an extremely low stage and considerable difficulty was encountered with high turbidity. At that time coagulation of the supply going to the city was accomplished by pumping an alum solution into the transmission line at Millbrae. The floc was allowed to settle in the distributing reservoir in the city. Excellent results were obtained in clarifying the water by this method. Experimental work was done with respect to similarly treating Calaveras water in the bay crossing pipe lines, the floc being allowed to settle in the transmission line, from which it could be cleared by blowoffs. Results were quite satisfactory when velocities were very low.

Chlorine and Ammonia Machines at Tesla Portal Station, Hetch Hetchy Aqueduct

UNREGULATED CROSS CONNECTIONS ELIMINATED

The San Francisco system, as far as is known, is entirely free from unregulated cross connections with other sources of water supply. Several years ago a survey was made by the Purification Division to locate all other sources of water supply and supervise their severance from the system. In most cases the severance was accomplished by means of double check valves especially installed in the main service to the consumers' premises. These check-valve installations are inspected for conformance with the regulations and are tested for leakage by the Purification Division at six-month intervals. In addition to this, a survey was made of a number of factory and other buildings in the city to eliminate unsanitary or hazardous conditions within the building piping. In 1938 a survey was made of all the hotels to eliminate hazardous conditions in anticipation of the 1939 Exposition. Of a total of 651 hotels examined, it was found that about 16 per cent maintained one or more serious plumbing hazards within the building. All these conditions were corrected before the exposition opened. This survey was made by the Water Department in cooperation with the Division of Plumbing Inspection of the San Francisco Health Department.

Frequent studies of the water in the various reservoirs is made to determine chemical and physical qualities. This work is done in connection with the withdrawal of water from the reservoirs so that the outlet gate best situated to give good water may be used. Operation of the outlet gates is changed from time to time to meet changing conditions in the water.

San Francisco has an abundant supply of water for many years to come. The sources around the bay region are capable of producing 60 mgd and the Hetch Hetchy supply has an ultimate developed capacity of 400 mgd. The water is of excellent chemical and physical characteristics and is unusually safe from the health standpoint. So far as is known, no case of typhoid fever has ever been caused by the San Francisco public water supply, even before chlorination was introduced.

THE GROVE HIGHWAY BRIDGE, CROSSING THE GRAND RIVER ABOUT 25 MILES UPSTREAM FROM PENSACOLA DAM

Water in the Future Lake Will Sometimes Rise as High as the Top of the Pier in the Foreground

Bridges of the Grand River Project

Five Crossings of as Many Different Designs Made Necessary by Construction of Pensacola Dam

By VICTOR H. COCHRANE

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CONSTRUCTION of the dam and reservoir for the Grand River hydroelectric project in Oklahoma called for the building of five bridges—two railway crossings, two highway crossings, and a combined railway and highway structure. The large size of the lake (50 miles in length and 46,300 acres in area at pool level) required the relocation of the two railroads, and the construction of the mid-lake highway bridge. The two other bridges are required at the dam—a combined railway and highway bridge across the river, and a highway bridge over the dam. All these structures are now completed except the last.

The mid-lake highway bridge is located about four miles northwest of the town of Grove at a point where the lake is only 4,000 ft wide. The structure is 2,548 ft long between faces of abutments, and the remainder of the crossing consists of earth embankments protected by heavy riprap. The bridge lies north and south, but will take care of both east-west and north-south traffic.

Allowing a 30-ft clearance above pool level for boats, the under side of steelwork at the center of the bridge is 103 ft above bedrock, which lies about 5 ft below ordinary low water. The economics of the design was based on the fact that the piers could be built practically in the dry, resulting in a layout quite different from what would be required if the bridge had to be built after the lake is filled. The economic span length was found be only about 120 ft. With such short spans and tall piers, simple-span deck trusses are preferable, inasmuch as they equalize longitudinal loads on piers. An effort was made to obtain a pleasing appearance without incurring extra expense other than for the ornamental railings. The bridge (Fig. 1) consists of fifteen 120-ft deck-truss spans, with six 60-ft deck I-beam spans at each end of the main spans. The reinforced-concrete deck provides a 24-ft roadway with curbs 20 in. wide for occasional pedestrian traffic. The deck is supported on 21-in. transverse beams, spaced 12 ft on centers throughout, thus simplifying the form work. The railing posts, of 6-in. H-sections, are firmly anchored to the concrete deck. The railing panels consist of two lines of 6-in. ship channels with verticals of 2 by $^3/_8$-in. flats welded to

EACH 120-FT TRUSS WAS ASSEMBLED AND RIVETED ON THE GROUND AND HOISTED INTO PLACE AS A SINGLE PIECE

IN this brief article Mr. Cochrane discusses the interesting features of five bridges of varied design—a deck-truss highway bridge, a concrete deck-girder railroad bridge on A-frame bents, a through plate girder railroad bridge, a railroad-highway bridge of I-beam spans on pairs of braced columns, and a highway bridge crossing a multiple-arch dam. All these structures are a part of the Grand River Project in Oklahoma, which was described in the September 1939 issue of "Civil Engineering."

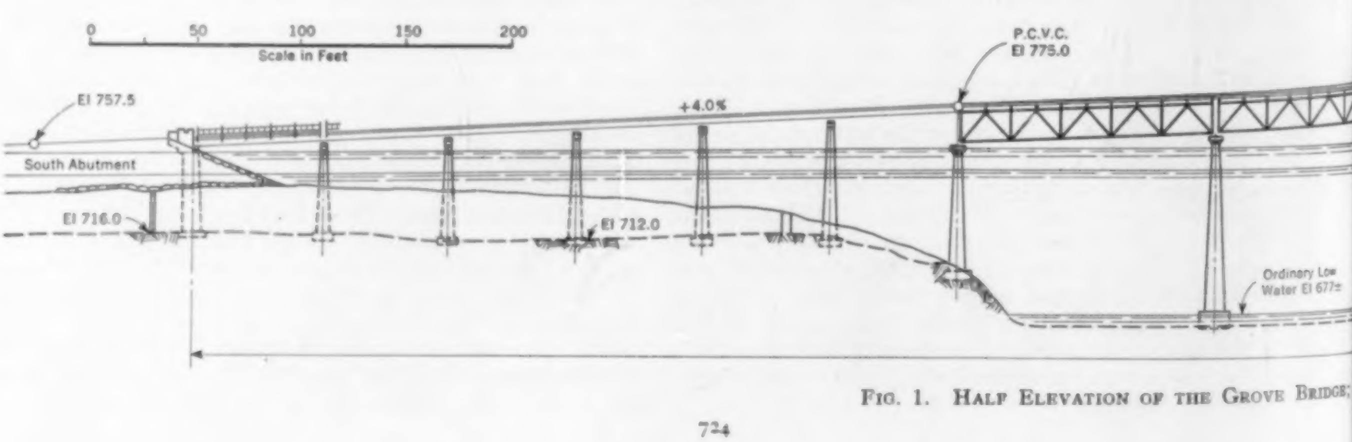


FIG. 1. HALF ELEVATION OF THE GROVE BRIDGE;

the channels. Conduit spaces are provided underneath the curbs. The superstructure is designed for H-15 loading.

The trusses are shallow enough (14 ft center to center of chords) to permit of shipment in three sections designed for a minimum of field riveting. After being assembled on the ground and riveted, each truss was raised vertically by a crane equipped with a 120-ft boom extended by means of a gooseneck. The lift was made

At Work on a Tall Shaft of the Grove Bridge

A Crane with 125-Ft Boom Handled the Plywood Forms and the 1-Cu Yd Concrete Buckets

through a special sling attached at the center top-chord panel point. The time required for this operation was about twenty minutes.

Piers under truss spans have I-shaped shafts rising on bases 12 by 28 ft in size. The inside faces of the pier

A-Frame Bents Without Longitudinal Bracing Characterize the Horse Creek Viaduct

The Brackets Were Used During Construction to Carry the I-Beams Supporting the Girder Forms

ends are vertical and the other three faces are battered $^3/_8$ in. to the foot. The shafts were poured regularly in sections 9 ft high. The forms were lined with plywood in uniform panels and the joint lines give the finished concrete a satisfactory appearance. The bents under I-beam spans consist of a pair of vertical columns with a top beam and transverse ties.

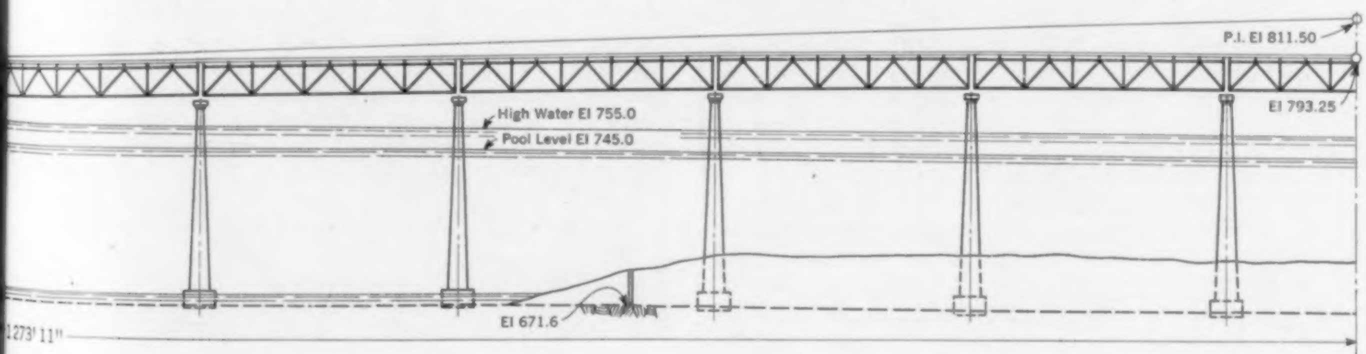
The truss spans are on a vertical curve 1,825 ft long, with the flanking I-beam spans on a 4 per cent grade. The trusses are cambered to this curve. Railing posts are perpendicular to the grade, and the abutment pylon faces are battered so as to parallel the end railing posts.

The construction cost of the bridge was $364,000, not including filled approaches, or $7 per sq ft, which is low for a structure of 120-ft maximum height. The contractor was Stanley E. Evans, of Fort Smith, Ark. The structural steel was furnished by the Virginia Bridge Company and the Patterson Steel Company.

A RAILROAD BRIDGE OF UNUSUAL DESIGN

The new bridge for the Kansas, Oklahoma and Gulf Railroad, crossing Horse Creek valley, a narrow arm of the lake, is of unusual design. The structure consists of twenty-four 40-ft concrete girder spans carrying a ballasted track and resting on rigid A-frame bents without longitudinal bracing (Fig. 2). It is designed for E-60 loading according to A.R.E.A. specifications. The maximum height is about 70 ft.

The outward inclination of the columns affords great lateral stability and minimizes bending moments from



…structure Is Symmetrical About the Center Line

RELOCATION OF THE ST. LOUIS–SAN FRANCISCO RAILWAY INVOLVED TRACK RAISING AND A NEW, EIGHT-SPAN, THROUGH PLATE GIRDER BRIDGE

transverse or unbalanced vertical loads. Longitudinal wind and traction forces are taken care of by battering the columns and providing long footings. All foundations are on limestone, and the maximum toe pressure is about $7^1/_2$ tons per sq ft. The brackets near the top of the bents were used as seats for I-beams to support forms during construction.

The embankment slopes are flat (1 on 3) and the surfaces are protected by heavy riprap. The end spans are cantilevered 6 ft beyond the abutments in order to keep the live load well back of the shoulder of the fill.

The Horse Creek viaduct was built by Moran and Buckner as subcontractors for M. E. Gillioz, at a cost of about \$133,200.

The new bridge for the St. Louis–San Francisco Railway is located 62 ft upstream from the old bridge. The superstructure consists of eight 77-ft 6-in. through plate girder spans flanked by two 30-ft deck I-beam spans at each end. The structure was designed for E-72 loading

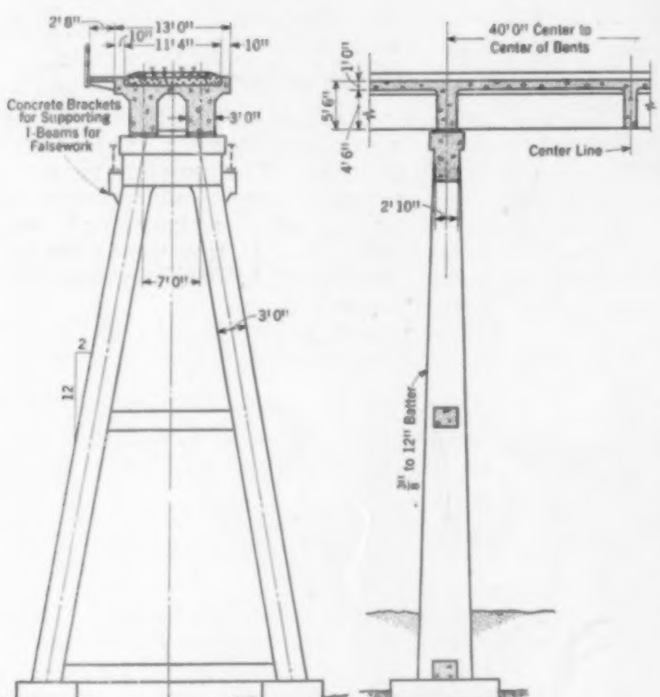


FIG. 2. TYPICAL TRANSVERSE AND LONGITUDINAL SECTIONS, HORSE CREEK VIADUCT

by R. B. Hennessy, bridge engineer of the St. Louis–San Francisco Railroad, under the direction of F. G. Jonah, M. Am. Soc. C.E., chief engineer. The contractor was Leo Sanders. The construction cost was about \$191,800.

The combined railway and highway bridge is about half a mile below the dam site. It spans the east channel of the river at an island, the west channel being filled. It was intended primarily for use during construction, but after completion of the dam and removal of the track it will serve as a highway bridge. The structure has twelve 40-ft I-beam spans resting on piers consisting of pairs of braced columns. After the dam is completed, flood waters will enter the river below the bridge, leaving only backwater and the discharge from the turbines to pass the structure. Leo Sanders built the bridge at a cost of \$65,000.

The highway bridge on top of the dam will be 5,678 ft long. The roadway is to be 20 ft wide, with a 4-ft sidewalk on the upstream side. On the spillway and nonoverflow sections there will be 32 spans 41 ft long center to center of piers. In each span there is a longitudinal

A CONSTRUCTION BRIDGE OF PERMANENT VALUE, DOWNSTREAM FROM PENSACOLA DAM

At Present It Carries a Construction Railway and Highway Floor. When the Tracks Are Removed, It Will Serve as a Highway Bridge

concrete girder at each curb line, with transverse floor beams. The construction for the arch and buttress section is unusual, in that the upstream side of the deck is supported by girders set in line with those used in the spillway section and carried directly by the water arches, while the downstream side is supported by open-spandrel arches spanning between buttresses. The girder over each buttress is cantilevered at each end about 6 ft beyond the support on the water arch to carry the ends of simple-span girders over the water arches. Construction of this bridge was started on November 1, 1939.

All these contracts were carried out under the direction of Holway and Neuffer, engineers for the Grand River Dam Authority, with the writer as consultant. The work was financed through a loan and grant agreement with the Public Works Administration.

Timber Research and Timber Structures

Progress of Research and Standardization Facilitates Design; Typical Applications of Timber-Connector Construction

By Ira D. S. Kelly

Associate Member American Society of Civil Engineers
Topeka, Kans.

It is the conclusion of the author that engineers are not sufficiently aware of the extent to which research and improvement in the design, fabrication, and preservation of timber structures has kept pace with similar modern developments pertaining to other structural materials. In this and an article to follow in the January issue, Mr. Kelly presents a review of recent developments that are extending the structural applications of timber to new and ever wider fields. The first article deals mainly with examples of timber-connector construction, but contains also a valuable and selective list of publications on phases of the general subject of interest to engineers, designers, fabricators, and specification writers. Next month various types of laminated construction will be discussed.

Within its limitations timber remains, as always, a structural material worthy of consideration for use in any structure. It has been shown by previous writers in Civil Engineering that in view of our present low rate of timber consumption, our existing commercial timber resources, reforestation, improved silviculture processes, sustained-yield growing and harvesting operations, and increased protection from fire, insects, and disease, we will always have a supply of timber adequate to meet our domestic and export trade requirements. Research in timber has kept pace with research in other structural materials, and technical literature and reports are available to those who wish to apply the results of this research. Any conclusion that to design in timber is to be old fashioned, or that the use of timber designs will bring closer a day of timber famine is not justified by the facts. Excellent species of structural timber are yet to be had in adequate quantity and satisfactory grade from the Pacific coast states, the Southern states, and several other producing regions.

Four developments of value to the users of structural timber have been carried forward progressively over a period of 28 years. The first is the accumulation of technical data, based on extensive research, making possible the preparation of reliable and complete designs and specifications for timber structures. The second is the standardization of sizes, shapes, and lengths of timber, permitting designs to be based on readily available commercial sizes. The third is the stress grading of structural timber, providing a correlation between the strength of different species in their commercial grades, and making it possible to choose that species and grade most closely conforming to the load-carrying requirements of the design. The fourth development is the preparation of use recommendations for all species and grades having practical application to timber structures, thus enabling the designer to choose a species and grade possessing required qualities, such as resistance to decay, appearance, workability, paintability, and so forth.

Fig. 1. Low-Truss Timber Highway Bridge near Lewisburg, Pa.

These four developments and many others are results of the work of the following agencies: the Forest Products Laboratory, Forest Service, U.S. Department of Agriculture; the American Lumber Congress meetings of manufacturers and government officials from 1919 to 1928; the Division of Simplified Practice, Bureau of Standards, U.S. Department of Commerce, under its then secretary, Herbert Hoover; the National Committee on Wood Utilization cooperating with the Bureau of Standards (disbanded in 1932); the Forest Products Division, Bureau of Foreign and Domestic Commerce, Department of Commerce; regional associations of manufacturers, such as the West Coast Lumbermen's Association and the Southern Pine Association; and the National Lumber Manufacturers Association.

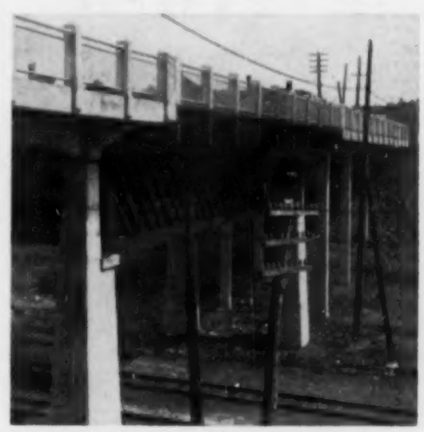


Fig. 2. Latticed Deck-Truss Timber Overpass at Cobalt, Ont.

Outstanding in the accumulation and publication of technical data pertaining to timber is the Forest Products Laboratory, first established in 1910 in cooperation with the University of Wisconsin and now occupying its own house of timber magic at Madison, Wis. That institution is devoted entirely to the investigation of wood and wood products and their adaptation to diversified fields of use. It has carried out, and is continuing, research in timber harvesting and conversion; silviculture relations; chemistry, composition, and derived products of wood; timber mechanics and structural research; wood seasoning and moisture control; wood treating for protection and service; wood pathology; and pulp and paper manufacture.

Under the impetus of this laboratory and a group of progressive timber producers, an American Lumber Congress was first convened in 1919 for the purpose of simplifying grading standards, developing a uniform basis for comparison between species grades, and stan-

FIG. 3. DEMOUNTABLE PORTABLE TIMBER MILITARY BRIDGE FOR DIVISION LOADS

dardizing lumber sizes. In 1921 the Department of Commerce organized the Division of Simplified Practice of the Bureau of Standards to put into effect the recommendations of the American Lumber Congress and other organizations with similar purposes. Up to the end of 1928 seven general lumber conferences had been held as cooperative undertakings between producers, distributors, and users of timber. These conferences resulted in the development and issue of the now familiar "Simplified Practice Recommendation" R16-29, which, with subsequent and continuing improvement, governs the size, shape, and grade standards of the lumber and timber producing industry.

Coincident with this work, a National Committee on Wood Utilization was organized in 1925 under the Department of Commerce cooperating with the Bureau of Standards and the Forest Products Laboratory. The objective of this committee was "to improve the utilization of our country's timber resources, both by encouraging research and by aiding the producing, distributing, and consuming industries to greater efficiency through applications of research results and the adoption of improved practices." The program of this committee is now being continued in part by the Forest Products Division of the Bureau of Foreign and Domestic Commerce, U.S. Department of Commerce, cooperating with the lumber industry.

The lumber industry, through its regional and national manufacturers' associations, has been instrumental in bringing about these developments, in putting them into operation, and in making their benefits known to producers and users of timber. Its most important contributions to printed data consist of a technical handbook, with supplements, comparable to the familiar *Pocket Companion*, and of a grade-use guide of value to engineers, architects, and specification writers. It has gone further, however, and has assisted in correlating timber specifications so that, except for differing forms and wording, the specifications of the American Association of State Highway Officials, the American Railway Engineering Association, the American Society for Testing Materials, and the American Society of Civil Engineers, are now substantially the same. The Society's specifications are contained in Manual 17 ("Timber Piles and Construction Timbers") prepared by the Waterways Division with the cooperation of the Construction Division and just published by the Society.

The results of research by the Forest Products Laboratory are available in the form of government publications, principal of which is the *Wood Handbook*. A partial and selected list of the more important publications on timber will be found at the end of this article.

TIMBER-CONNECTOR CONSTRUCTION

A revolutionary improvement in timber construction during recent years is the development and use of timber connectors. One of the research projects of the National Committee on Wood Utilization, the Forest Products Laboratory, and the Bureau of Standards, was a study of European methods of design and construction involving the use of metal or wood connecting devices. More than sixty types of timber connectors were found in use in Europe. Eight of these, giving promise of adaptation to American timbers, were tested by the Forest Products Laboratory, and a report made public. Realizing the vast extension in the use of structural timber that would be made possible through the introduction of timber connectors in the United States, the National Lumber Manufacturers Association through its subsidiary, the Timber Engineering Company, secured the right to manufacture and sell three of the most important types. Since that time it has developed a number of new types, and has carried forward a progressive development, promotion, and engineering program.

Timber-connector construction is characterized by the efficient structural use of timber in either tension or compression, using relatively thin and wide timbers lapped at their joints or joined by plywood or steel gusset or splice plates. An appropriate type of timber connector is installed between the contact faces of the lapped timbers or plates. Timber-connector construction makes possible the complete fabrication and partial or complete assembly of timber structures working from shop details and templates, and employing methods closely comparable to structural-steel fabrication practices. Fabrication of timber for timber-connector construction prior to preservative treatment is being done successfully with or without an initial moisture-reducing treatment. Ease of assembly may be increased by fabricating previously dried timber.

REPRESENTATIVE STRUCTURES USING TIMBER CONNECTORS

Many outstanding examples of timber-connector structures in the United States and Canada might be mentioned. A few such structures, representative of this type of construction, are pictured and briefly described here.

On a secondary highway near Lewisburg, Pa., a modern timber-connector low-truss bridge was built in 1936 to replace a covered timber bridge in service for more than a century. (The previous bridge was floated from its foundations by backwater from the adjacent Susquehanna River and deposited upstream.) The new bridge, shown in Fig. 1, was designed by the writer for the unusual combination of a 12-ft roadway and an H-20 loading on two spans, each 91 ft 6 in. from center to center of bearings, resting on the recapped existing foundations.

FIG. 4. ONE OF FIVE SECTIONS OF A FLOATING DRYDOCK AT PORTLAND, ORE.

All timber was a 1600#f grade southern yellow pine prefabricated green from shop details and pressure-treated with creosote oil. All hardware, including timber connectors but excluding steel plates and devices, was galvanized. Except where steel plates occurred, $^1/_2$-in. timber bolts, with washers upset or cast integrally with heads and nuts, were used. In all timber-to-timber connections, $2^1/_2$-in. split-ring timber connectors were used. Under steel splice plates, on the outside of splices, $3^1/_8$-in. toothed and hubbed shear-plate timber connectors were employed. At the hip joints steel gusset plates were placed between and outside all members, and $2^5/_8$-in. flanged hubless pressed-steel shear-plate timber connectors were used with $^3/_4$-in. bolts. Compression members were designed as spaced columns. Floor beams were double timbers attached to the projecting ends of the truss verticals below the bottom chords and extending outward to engage single outrigger timbers attached at their upper ends to the truss verticals below the top chord. A longitudinal continuous composite timber-concrete floor was spiked to crowned nailing strips in turn attached to the tops of the floor beams with lag screws. Wrought-iron cut spikes were used in the floor. The handrail was painted aluminum for greater visibility.

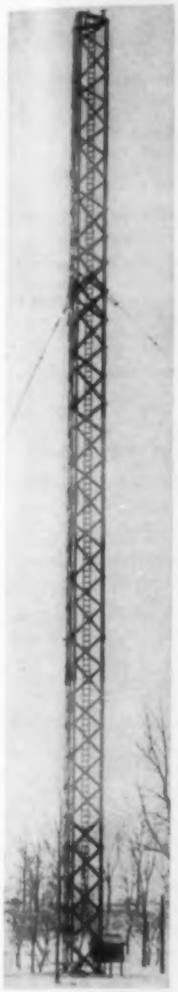


Fig. 5. Triangular Timber Radio Tower at University of North Dakota

For a railway overpass bridge on a primary highway at Cobalt, Ontario, the writer designed a timber-connector deck truss (Fig. 2) for a span of 90 ft, a roadway of 24 ft, a sidewalk of 5 ft, and an H-20 loading. A 6-in. longitudinal laminated timber floor was supported on floor beams with crowned nailing strips. The floor beams were single timbers supported on the top chords of the truss at the panel points. Every third floorbeam extended out to support the sidewalk. The depth of trusses was 9 ft 0 in. from center to center of chords, and latticed bracing was used. The chords were spliced at the approximate one-third points, and camber was introduced by increasing the length of the top chord. Split rings and toothed hubbed shear-plates were used without galvanizing. A 1600#f stress grade of British Columbia fir was used throughout except for the floor. The timber was prefabricated from shop details and pressure-treated with creosote oil on the Pacific coast prior to shipment.

Fig. 6. Circular, Parallel-Chord, Double-Intersection, Warren-Type Timber Arches for a Skating and Curling Club at Superior, Wis.

In Fig. 3 is shown a portable demountable timber-connector military bridge designed by enlisted personnel of the 108th Engineers, Illinois National Guard, and fabricated and erected at Camp Grant, Ill. Such timber-connector bridges closely approach the ideal solution of the military bridge problem.

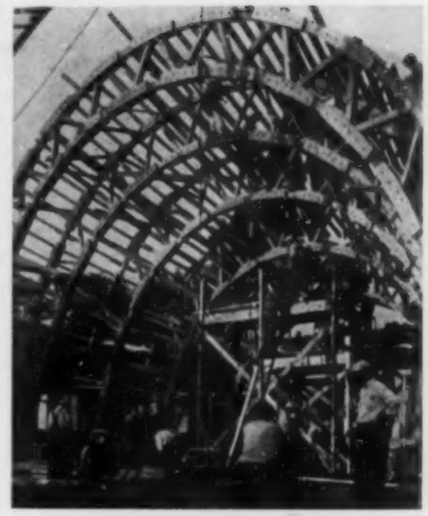


Fig. 7. Framework of a Band Shell

This bridge was designed for a 30-ft span, 9-ft roadway, and $7^1/_2$-ton tank load (the maximum load of a division). It utilized dense, select, and dry Douglas fir timber from an obsolete pontoon bridge. Interchangeable steel K-shaped gusset plates were used with toothed and hubbed shear-plate timber connectors. No single timber was too heavy for two men to handle readily, and all timber could be loaded in $1^1/_2$-ton trucks. Similar military bridges even more easily handled and assembled are possible through the use of plain-flanged hubless shear-plate timber connectors.

Figure 4 shows a timber-connector structure in process of completion for the Port of Portland, Ore. Five sections like the one in the photograph will be joined to form a floating drydock 126 by 450 ft, using 1,250,000 fbm of Douglas fir timber. Each section consists of a pontoon supporting two framed timber towers sheathed with barge plank to make them watertight, and with operating equipment installed in the towers. The timber was prefabricated by Timber Structures, Inc., of Portland, Ore., and pressure treated, using a proprietary salt process, by the Crosset Western Company at Wauna, Ore.

The triangular radio tower shown in Fig. 5 was designed by L. H. Nishkian, M. Am. Soc. C.E., and erected at the University of North Dakota at Grand Forks. It is of untreated Douglas fir, and stands 166 ft high. This tower was prefabricated at Oakland, Calif., by A. C. Horner, M. Am. Soc. C.E., of the Timber Engineering Company of California; $2^1/_2$-in. split-ring timber connectors were used.

Three of the seven roof arches for the Superior Curling and Skating Club building at Superior, Wis., are shown in Fig. 6. They use untreated select structural Douglas fir timber, with split-ring timber connectors, and have a span of 125 ft and a rise of about 42 ft. The arches were fabricated at the site, using WPA labor, and erected in place on movable falsework towers. R. C. Buck, M. Am. Soc. C.E., was the designer.

Another project using circular framed timber-connector arches is pictured in Fig. 7. The arches are each of a different radius, and are so arranged as to form a band shell when sheathed inside and out. This structure, on the Michigan State Fair Grounds, was designed and built by R. A. McGrath, consulting engineer of Detroit. Only ten days were required for truss erection.

Figure 8 shows a timber-connector automobile loading dock at Detroit, Mich., also designed and erected by Mr.

FIG. 8. AUTOMOBILE LOADING DOCK AT DETROIT

McGrath. This structure uses spaced timber columns to support prefabricated and assembled roof trusses, connected by trussed purlins running the length of the building. Timber blocks between the truss chord timbers provide support for solid-section purlins.

Use of timber-connector roof trusses in a warehouse is illustrated by Fig. 9. The trusses have a span of 67 ft, are spaced 22 ft on centers, and are designed for a total dead and live load of 52 lb per sq ft plus a single concentrated load of 14,000 lb at any point on the bottom chord. The top chords consist of lapped timbers with their tops cut to a curve. Roof joists, 6 by 14 in., rest at the truss panel points about 7 ft on centers and support 2-in. sheathing bent to the curve of the chord. Bridge cranes are carried on rails attached to the ends of the trusses rather than supported on column brackets. Thirty-five trusses were used over three bays, each 67 by 300 ft. The warehouse was designed for Woodbury and Company of Portland, Ore., by Richard Sundeleaf, architect, and the general contract was held by Charles Wegman and Son, both of Portland. The roof trusses were designed and erected by Timber Structures, Inc., of Portland.

BOLTED, SCREW-CONNECTED, AND NAILED CONSTRUCTION

For large loads bolted construction has been largely superseded by timber-connector construction because the latter results in a more efficient use of structural timber. Nevertheless, through the intelligent use of readily available technical data, bolted connections entirely adequate to transfer specific loads may be designed and constructed with confidence.

Timber construction using screws is less common but can be adequately designed, utilizing similar data contained in the *Wood Handbook* and a recently published bulletin on lag screws.

Timber "carpenter trusses" nailed together in accordance with the individual carpenter's conception of what constitutes an adequate truss sometimes give long and satisfactory service; yet the lack of adequate consideration of the stresses to be carried too frequently results in failure. Reasonably complete design data on the strength of nailed connections and the rules governing their design are now available.

SELECTED LIST OF TECHNICAL PUBLICATIONS ON TIMBER

Available from the U.S. Government Printing Office, Superintendent of Documents, Washington, D.C.:

Wood Handbook. U.S. Department of Agriculture, Sept. 1935, illus., 325 pp. 25 cents. Basic information on wood as a material of construction with data for its use in design and specification.

Lumber. Simplified practice recommendations. Fourth edition, R16-29, July 1929, 92 pp. 30 cents.

Supplement to above, No. 1932, 49 pp. 10 cents.

Strength and Related Properties of Woods Grown in the United States. U.S. Department of Agriculture, Technical Bulletin No. 479, Sept. 1935, 99 pp. 25 cents.

Strength-Moisture Relations for Wood. U.S. Department of Agriculture, Technical Bulletin No. 282, 1932, 88 pp., illus. 20 cents.

Kiln Drying Handbook. U.S. Department of Agriculture, Bulletin No. 1136, Rev. 1929, 96 pp., illus. 30 cents.

Lag Screw Joints, Their Behavior and Design. U.S. Department of Agriculture, Technical Bulletin No. 597, 1938, 27 pp., illus. 10 cents.

The Bearing Strength of Wood Under Bolts. U.S. Department of Agriculture, Technical Bulletin No. 332, Oct. 1932, 40 pp. 5 cents.

Modern Connectors for Timber Construction. U.S. Department of Commerce, National Commission on Wood Utilization, 1933, 144 pp., illus. (Out of print, but has been widely distributed.)

Gluing of Wood. U.S. Department of Agriculture, Bulletin No. 1500, 1929, 78 pp., illus. 25 cents.

Douglas Fir Plywood (Domestic Grades). Commercial Standard, CS 45-38, third edition, 1938, 20 pp., illus. 5 cents.

Effectiveness of Moisture Excluding Coatings on Wood. U.S. Department of Agriculture, Circular No. 128, 1930, 28 pp., illus. 10 cents.

Manual of Preservative Treatment of Wood by Pressure. U.S. Department of Agriculture, Miscellaneous Publication No. 224, Aug. 1935, 117 pp. 15 cents.

Available from the National Lumber Manufacturers Association, 1337 Connecticut Avenue, Washington, D.C.:

Wood Structural Design Data. First edition, 1935, 296 pp. $1.00. A concise presentation in a convenient form of data and tables essential to the adequate and rapid design of timber structures using any species and grade of structural timber.

Working Stresses for Structural Lumber and Timber. Supplement No. 1 to above, 1936, 2 pp.

Bolted Wood Joints, Safe Loads on Common Bolts. Supplement No. 2 to above, 1935, 2 pp.

Maximum Spans for Joists and Rafters. Supplement No. 3 to above, 1935, 16 pp.

Wood Columns—Safe Loads (Solid and Spaced Columns). Supplement No. 4 to above, 1936, 24 pp, tables and graphs.

Wood Trusses—Stress Coefficients (Length Coefficients and Angles). Supplement No. 5 to above, 1937, 46 pp.

(Supplements Nos. 1 to 5, 25 cents.)

Lumber Grade-Use Guide for Softwood and Hardwood Lumber in Building and General Construction. $1.50. 11 Producer's Association pamphlets containing recommendations and specifications for the most desirable species and grade of structural timber for specific uses.

Manual of Timber-Connector Construction. A statement of safe loads on three types of timber connectors, and recommended practice in timber-connector design and construction. No charge.

Available from the West Coast Lumberman's Association, 364 Stuart Building, Seattle, Wash.:

Douglas Fir Use Book (Structural data and design tables). Edition 1935, 210 pp. $1.00.

Available from the Southern Pine Association, New Orleans, La.:

Southern Pine Manual of Standard Wood Construction. Edition 1937, 199 pp. $1.00.

Available from the American Association of State Highway Officials, 1220 National Press Building, Washington, D.C.:

Standard Specifications for Highway Bridges and Incidental Structures. Second edition, 1935. $1.00.

Available from the American Railway Engineering Association, 59 East Van Buren Street, Chicago, Ill.:

Specifications for Structural Timbers. 1936, with chapter on "Wood Bridges and Trestles," 112 pp., 14 drawings. $1.50.

Available from the American Society for Testing Materials, 260 South Broad Street, Philadelphia, Pa.:

Standard Specifications for Structural Wood Joist and Plank, Beams and Stringers, and Posts and Timbers. American Society for Testing Materials, Designation D 245-37, 24 pp. 25 cents.

Available from the American Society of Civil Engineers, 33 West 39th Street, New York, N. Y.:

Timber Piles and Construction Timbers. Manual 17 of the American Society of Civil Engineers, 48 pp. 70 cents (50 per cent discount to members).

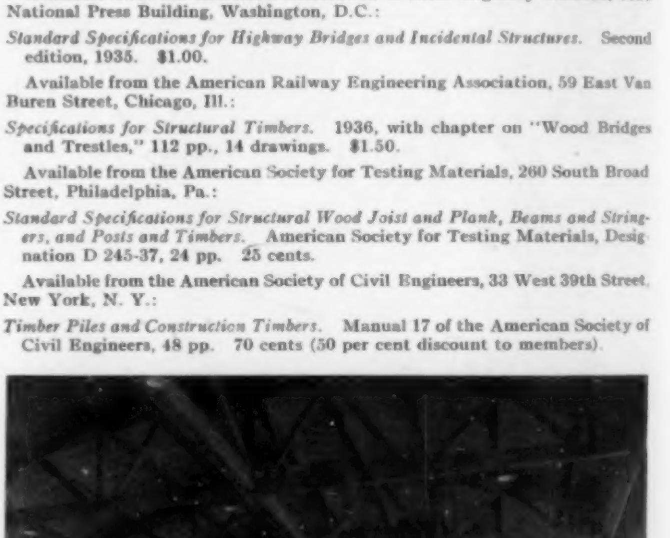


FIG. 9. TIMBER ROOF TRUSSES IN A WAREHOUSE AT PORTLAND, ORE.

The Technique of Triaxial Compression Tests

By John D. Watson
Associate Member American Society of Civil Engineers
Assistant Professor in Civil Engineering, Duke University, Durham, N.C.

To determine completely the stress deformation characteristics of a soil, a triaxial compression apparatus is useful and in some cases essential. The type described here was developed by Prof. Watson and had its first practical application on studies for the Franklin Falls Dam. His article includes an explanation of the testing technique and a brief presentation of typical results. It was originally presented before the Society for the Promotion of Engineering Education at its annual convention in June 1939.

When Karl von Terzaghi was lecturing on soil mechanics at Harvard University in 1936, he often spoke of the triaxial compression test as the best means of determining the stress-deformation characteristics of soils. In his lectures he would sketch on the blackboard a prismatic sample of soil, sealed in a thin rubber membrane and enclosed in a vessel under hydrostatic pressure, the interior of the sample being open to the atmosphere for drainage through a small tube. A piston, which passed through a packing gland in the pressure vessel, applied a vertical load longitudinally to the sample until rupture occurred. The state of stress in this sample of soil at the point of failure he would then determine from Mohr's circle of stress. But few if any such pieces of apparatus were in use in the United States at that time. The principal difficulty was the need for a tight packing gland, which produced too much friction on the piston.

In 1937 the U.S. Engineer Office in Boston, Mass., was confronted with the necessity of constructing, out of a fine silty sand, a large earth dam for flood control purposes. The safety of an embankment constructed of such material was a question deserving special consideration, since Casagrande had shown that a large mass of fine-grained soil is inherently unstable unless it is compacted below the critical void ratio. (See Arthur Casagrande, "Characteristics of Cohesionless Soils Affecting the Stability of Slopes and Earth Fills," *Journal of the Boston Society of Civil Engineers*, January 1936.) When the construction of this dam at Franklin Falls, N.H., was first proposed, the question immediately arose as to how densely the material should be compacted to be safely below the critical void ratio. After an extensive investigation by means of direct shear tests, which did not lead to a satisfactory solution, it was decided to adapt the principle of triaxial compression to the study of the problem.

Casagrande suggested to the writer that a viscous fluid such as glycerin would permit the use of a practically frictionless piston and would make the leakage around the piston insignificant. Following this suggestion the writer had a triaxial compression apparatus built which would maintain a constant pressure for several hours, and in which the friction did not exceed 2 per cent and averaged less than 1 per cent of the load.

It was then necessary to develop a technique of testing for cohesionless soils such that the following initial steps could be successfully accomplished: (1) The soil must be packed into a rubber tube; (2) it must be sealed air-tight and held under a vacuum until the hydrostatic pressure can be applied through the glycerin; (3) its weight and total volume must be known for computation of the void ratio; and (4) it must be completely saturated with water. When this is done, the pressure chamber is assembled around the sample, and the glycerin is pumped in by air pressure. Then a vertical load is applied to the sample by the piston until failure occurs.

A cross-sectional sketch of the triaxial compression chamber is shown in Fig. 1. The carefully prepared sample (10) enclosed in an air-tight rubber membrane (9), rests on a porous disk set into a pedestal which is an integral part of the base (12). The wall of the compression chamber is a cylinder (6) of "Lucite," a transparent plastic, and soft rubber gaskets (11) are provided at each end. A steel piston rod (1) $^3/_4$ in. in diameter passes through the center of the head (3), transmitting the vertical load from the loading machine to the sample. This head is merely a cast circular plate with a long boss (4) on both its upper and under sides, an air vent, and a trough (2) to catch any glycerin leakage. The piston is lapped in to a smooth sliding fit. The length of the bosses reduces to a minimum any tendency for the piston to bind, and increases the length of path of escape for the glycerin.

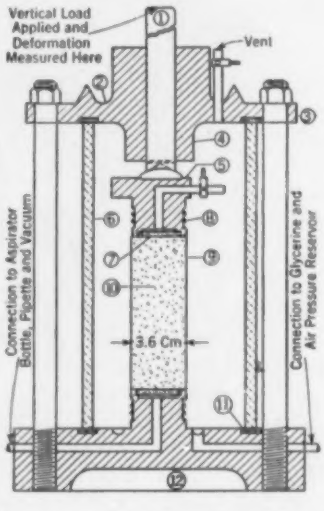


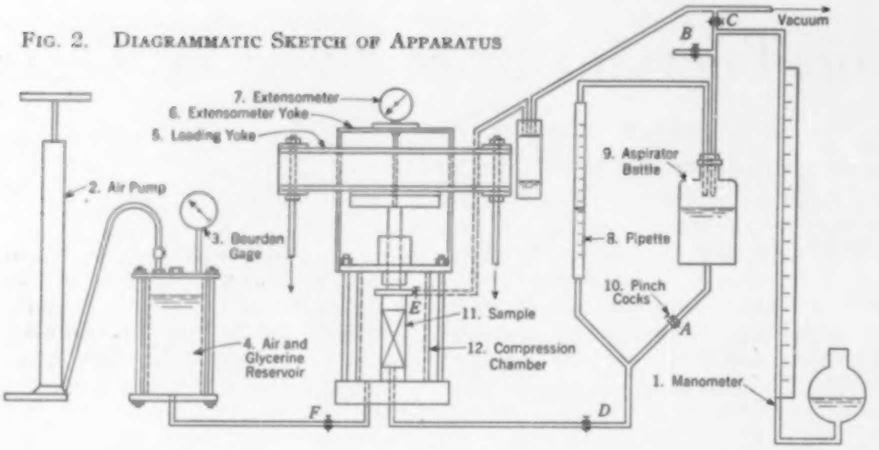
Fig. 1. Sectional Sketch of Triaxial Compression Chamber

The cap (5) for the sample itself is similar to the pedestal in the base. A porous stone (7) in the cap connects through two counterbores with a pet-

List of Symbols

σ_1	=	major principal stress
σ_2	=	intermediate principal stress
σ_3	=	minor principal stress
(σ_2	=	σ_3 in this testing apparatus)
V_v	=	volume of voids in the sample
V_s	=	volume of solid in the sample
D_d	=	degree of density (relative density as defined by Terzaghi)
e_o	=	initial void ratio, that is, the void ratio under a vacuum of approximately 0.95 kg per cm^2
e_p	=	void ratio at the start of the test proper, that is, after compression by the glycerin
δ_m	=	unit strain corresponding to maximum stress, in per cent of height of sample at start of test proper
Δ_F	=	magnitude of volume change at failure, in per cent of volume of voids at start of test
ϕ	=	angle of internal friction

FIG. 2. DIAGRAMMATIC SKETCH OF APPARATUS



cock and hose nipple on the side. This connection, as well as a similar one in the base, is necessary for saturating the sample with water prior to testing. The contact between the piston and the cap is designed so that it will not exclude the hydrostatic pressure over the area underneath the piston rod, and at the same time it will produce a strictly vertical load. To accomplish this a steel hemisphere is seated in the cap, while a conical counterbore is made in the piston rod. The apex of this counterbore is opened to the hydrostatic pressure by a small hole drilled perpendicular to the axis through the piston rod. This arrangement results in a circular line-contact between the piston and cap, which permits rotation, and yet never excludes the hydrostatic pressure.

A simplified sketch of the whole apparatus is shown in Fig. 2. The triaxial compression chamber (12) can be placed in any compression testing machine. A loading device that utilizes a platform scale and a screw jack is quite satisfactory, though a constant-strain testing machine is preferable. The loading yoke (5) is straddled by a lighter yoke (6) which is rigidly fastened to the head of the compression chamber. This light yoke carries an extensometer dial (7) to measure the vertical compression of the sample (11) under load.

A rubber tube running to the right from the center of the base connects with a 10-cc. pipette (8) and a glass aspirator bottle (9). The top of the latter is connected to a vacuum pump. A reinforced rubber hose running to the left from the base connects with the glycerin and air pressure reservoir, whose purpose is to fill and empty the compression chamber with glycerin and provide a sufficient air reservoir to maintain the hydrostatic pressure constant despite a small loss of glycerin. Since the Bourdon gage (3) is not very accurate for low pressures, a mercury manometer is preferable for measuring any pressure less than two atmospheres.

PREPARING THE SAMPLES

The first step in preparing a sample for testing is to bind a rubber tube to the base pedestal with several turns of strand rubber stretched very tightly. In order to mold a cylindrical sample of soil and hold it in shape until the vacuum can be applied, a metal shell, or forming jacket, is necessary. The internal diameter of this shell must equal the diameter of the pedestal plus the thickness of the rubber tube, and its height must equal the height of the sample plus the height of the pedestal. The shell is placed around the tube and clamped fast, and the top end of the rubber tube is turned down over it. A known weight of dry cohesionless material is then placed inside the tube, being poured through a funnel for a "loose" sample, or tamped in thin layers for a "dense" sample. Considerable care must be taken to have a uniform density throughout the entire sample.

When the tube is completely filled with soil, the cap is put on and leveled by setting a small spirit level on top. The rubber tube is then turned up around the cap, and a vacuum is applied at the base. This makes the sample and cap rigid so that it is easier to apply bindings to the cap. Next, a vacuum is also applied at the top of the sample. After several minutes pinchcock A (Fig. 2) is opened and water flows in to the sample by gravity. When the sample is fully saturated a vacuum is reapplied to the sample bottom through the aspirator bottle, petcock E is closed, and the vacuum line is removed from it. The sample is completely saturated, and being also under a vacuum will stand erect when the metal shell is removed. The external dimensions of the sample are taken and its volume is computed. As the dry weight of soil in the sample is known, the void ratio can now be computed.

The compression chamber is then placed in position and the head bolted down; the air pressure is increased in the air and glycerin reservoir; and glycerin flows into the compression chamber. When the compression chamber is completely filled with glycerin, the air pressure can be set at any desired value. Observations of the water level in the pipette before and after application of the glycerin pressure (with pinchcock A closed) give a measure of the volume reduction of the sample due to hydrostatic compression. With pressure in the glycerin, the vacuum of the interior of the sample can be released. The pinchcock A is then closed, so that all changes in the volume of the sample will now be shown by a rise or fall in the water level of the pipette.

In the usual type of test the sample is loaded vertically, the lateral pressure being maintained constant. The data consist of observations on load, deformation, and volume change. When the water level in the pipette rises, water is being squeezed out of the sample, the volume of the sample decreasing. Contrarily, when the water level in the pipette goes down, the sample is taking in water, and increasing its volume.

For illustration, the results of two tests on the silty fine sand from Franklin Falls, N.H., are

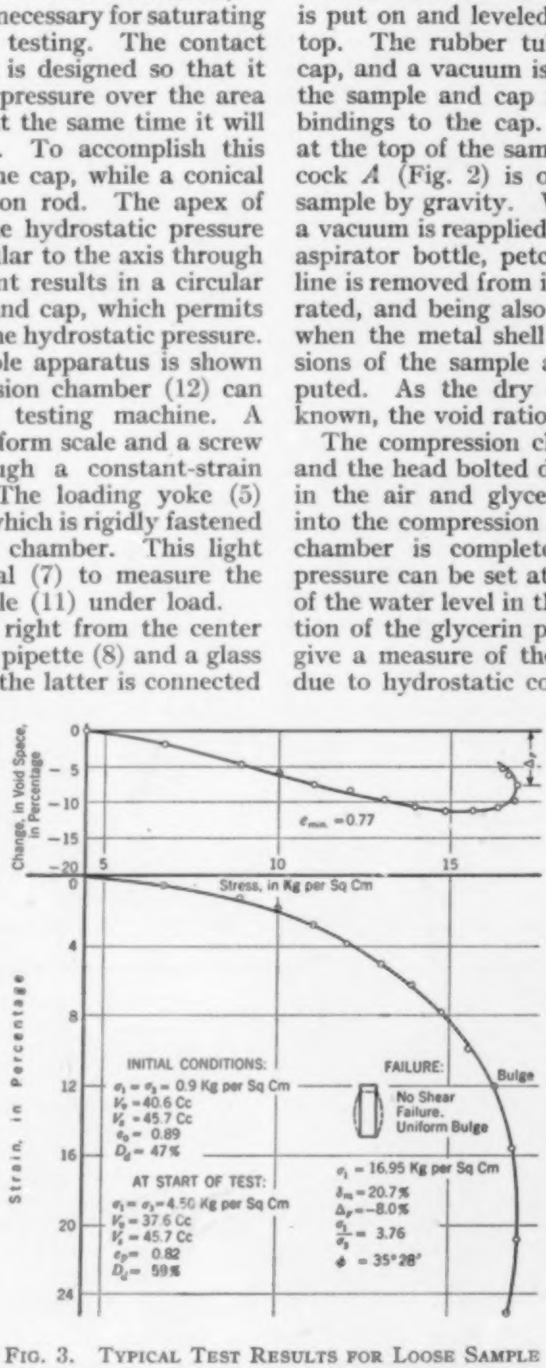


FIG. 3. TYPICAL TEST RESULTS FOR LOOSE SAMPLE

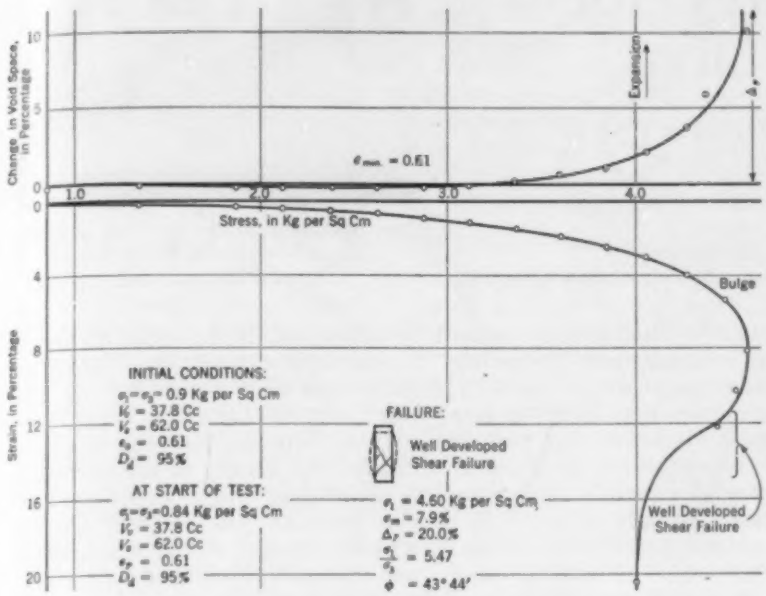


FIG. 4. TYPICAL TEST RESULTS FOR DENSE SAMPLE

given in Figs. 3 and 4. The volume changes are expressed as a percentage of the void volume at the start of the test—that is, the void volume that exists after the hydrostatic compression. A volume increase is given a positive sign, and a volume decrease a negative sign. The strain is computed from the height of the sample at the start of the test, that is, after the hydrostatic compression. The following correction is made for the area increase of the sample:

$$\text{Corrected area} = \frac{\text{original area}}{1.0 - \text{strain}}$$

The unit vertical stress in the sample (σ_1 in this type of test) is computed for each increment of load (or strain) by adding to the unit external pressure the unit hydrostatic pressure (σ_3 in this type of test). Failure is assumed to occur when the unit vertical stress, σ_1, becomes a maximum. At this point the angle of internal friction, ϕ, can be computed from the relationship $\sigma_1 = \sigma_3 \tan^2 \left(45 + \frac{\phi}{2}\right)$. (This relationship is true only when applied to materials which have a straight-line relationship between normal stress and shearing stress. Not all sands can be included in this category.) The rate of loading (or strain) is chosen such that a complete adjustment of volume is accomplished after each increment.

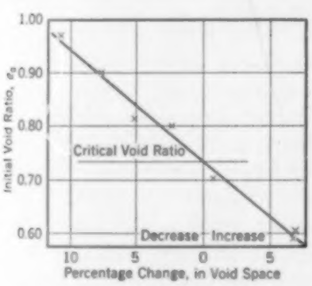


FIG. 5. VOLUME CONDITION AT MAXIMUM STRESS

BEHAVIOR OF TYPICAL LOOSE SAMPLE UNDER TEST

A plot of data for this material tested in a loose state is shown in Fig. 3. This sample continuously decreased in volume until just at the point of failure, when there was a slight increase. The net result, however, was a much smaller volume at failure than at the start of the test. After reaching a maximum stress this sample continued to deform without any further increase in load. There was no evidence of rupture; the sample failed by plastic flow, which was indicated by the uniform bulging.

BEHAVIOR OF DENSE SAMPLE

The same material tested in a dense state will have a stress-strain curve as shown in Fig. 4. In these two cases the minor principal stresses were different, but this has no effect on the general shape of the curves. In the test shown in Fig. 4 the sample decreased slightly in volume until the load was 50 per cent of the maximum. Then the sample began to expand rapidly. Soon after reaching the maximum stress, shearing planes began to appear and the load continued to fall off until it was less than 90 per cent of the maximum. At this point the volume change practically ceased and the sample continued to deform with no further change in load. In this case the failure was a distinct rupture along definite shearing planes.

One very striking result of these and many other tests is the greater strength and the greater rigidity of the sands in a dense state as compared with the same sands in a loose state. More significant, however, is the fact that before reaching failure the loose sample decreased in volume and the dense sample increased. How this phenomenom can affect the stability of earth embankments has been explained by Casagrande (op. cit., page 20). That void ratio which at failure is neither larger nor smaller than it originally was before application of load, he has called the critical void ratio. It is not easy to prepare a sample the void ratio of which corresponds to this critical value. Nevertheless, by performing a series of tests at the same lateral pressure and varying only the initial void ratio, an approximately straight-line relationship is found to exist between the void ratio and the percentage of volume change at that particular pressure (Fig. 5). When the lateral pressure is increased, the amount that a loose sample will contract is also increased, and the amount that a dense sample will expand is reduced. The critical void ratio is therefore not a constant, but varies with the magnitude of the lateral pressure (Fig. 6). The amount of this variation differs with different materials. For Ottawa standard sand, it was found to be very small.

Finally, the intensity of the volume change and the ratio of the major principal stress to the minor principal stress have both been found to be independent of the size of the sample used.

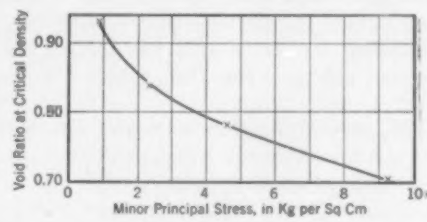


FIG. 6. TYPICAL RELATIONSHIP BETWEEN VOID RATIO AT CRITICAL DENSITY AND MINOR PRINCIPAL STRESS, FOR A SAND

The development of the triaxial apparatus described here, and the investigations outlined, were made possible by a cooperative agreement between the U.S. Engineer Office in Boston, Mass., and Arthur Casagrande, Assoc. M. Am. Soc. C.E., who served as supervisor. The writer wishes to express his sincere thanks to Col. A. K. B. Lyman, M. Am. Soc. C.E., District Engineer in Boston, and to Capt. J. H. Stratton, Assoc. M. Am. Soc. C.E., whose initiative made possible the work here described.

A Unique Library for American Samoa

Modern Engineering Principles Effectively Grafted Onto an Ancient Architectural Form

By P. J. Halloran

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The Samoan Library at Time of Dedication—Interior Furnishings Not Yet Installed

AS a result of a broad field of undertaking, unusual tasks frequently fall to the lot of engineers in the U.S. Navy. The construction described here by Commander Halloran may well be classed as extraordinary, as there is only one bit of the earth's surface on which it could have been accomplished. This story of how he not only utilized modern construction principles and methods in producing a masterpiece of native architecture, but also adapted and coordinated the labors of the Samoans themselves, makes interesting reading.

FOR more than two years Capt. Macgillivray Milne, U.S. Navy, the governor of American Samoa, studied the possibility of creating a library for the Samoan people. The need for it had long been evident to those interested in the educational welfare of the people. Naturally the greatest handicap was to secure adequate funds for the undertaking. The interest of many individuals, especially in Honolulu, was solicited and sufficient donations were received to justify the start of preliminary investigations on the type of building to be erected.

Various types of structure were considered, including a frame building along the lines of other small tropical libraries, and a reinforced concrete structure, both about 25 by 46 ft in plan. A frame building was considered undesirable because of the rapid deterioration that overtakes foreign timber in Samoa from termites and dry rot, and a concrete structure presented the difficulty of excessive initial cost.

Shortly after his assignment to the Naval Station at Samoa as Public Works Officer and Superintendent of Public Works in the island government, the writer became intensely interested in the beauty and engineering possibilities of the native Samoan architecture, and proposed the construction of a library in native style (called in Samoan a *fale afolau*, or "long house") with improvements in certain structural details to materially increase resistance to the severe climatic conditions in Samoa.

Almost immediately great interest was aroused in this proposal. Meanwhile the receipt of additional contributions made it possible to plan on accommodating 7,000 books, increasing the required width of the building to 30 ft and the length to 84 ft—dimensions somewhat greater than those of any similar existing structure.

To one unfamiliar with the great importance attached to the procedure of house building by the native Samoan, this might not appear to be an extraordinary undertaking. Every Samoan chief desires to have a long house in his village as an indication of his prestige. These structures are built exclusively by Samoan builders known as Latus, banded together in an organization, "Agaiotupu," descendants of the ancient builders of Sa Tagaloa (mythical god of house building in Samoa). While the building is under construction, the Latu and his assistant occupy a position of honor in all ceremonies conducted by the chief and his family.

An Interior View. The Frieze Around the Stacks, Containing Fourteen Samoan Proverbs, Was Given by Mrs. Macgillivray Milne as a Memorial to Her Son

It was intended that the construction of the library in the form of a Samoan long house would serve a dual purpose—fill the great need for a public library, and arouse interest in perpetuating the native architecture, which was beginning to be abandoned because of its high cost. If the library were to fulfill this second aim, it must be so designed and constructed as to meet with the fullest approval of the native builders and embody the finest traditions of their guild. They attach great importance to such matters as the shape of the structure, the position of the interior columns, the wall columns, the joints; the method of tying the members together with the native cord known as sennit; the divisions of the house; and the proper designation of individual members to comply with an elaborate and ancient tradition. Realizing that with foreigners attempting to duplicate the craft of the Samoan the work would be especially open to their criticism, every endeavor was made to carry out as thoroughly as possible the many details called to attention by the several friendly native critics who advised while the basic plan was being prepared.

MAIN FEATURES OF THE SAMOAN LONG HOUSE

A Samoan long house is composed of three distinct sections—a straight central section and two semicircular end sections (Figs. 1 and 2). The principal interior columns are connected at the top longitudinally by main plates and transversely by superimposed cross beams. The longitudinal tie connects the centers of these beams; on it, at the points where it crosses the beams, rise the king posts, which in turn support the cross struts, the knee braces, and the ridge pole. Small curved round rafters are tied into a mat over the longitudinal purlins. The lower end of this mat is supported by a round wall plate, resting on the closely spaced exterior columns. This comprises the center section of the building.

In each end section the lower members, including the wall plate and the exterior columns, are similar to those in the center section except that they are laid on the periphery of a semicircle. The roof of the end sections is made up of curved ribbed arches in short shaped pieces that vary in shape from the lowest, which is practically semicircular, to the topmost, which is essentially parabolic. The end sections are entirely dependent upon these arches, combined with the tightly woven mat of small rafters, to support the weight of the roof. All the members of the structure are tied together by sennit, a flat native cord made by braiding the long fibers of green cocoanut. The roof of the standard

Samoan building is thatched with a shredded sugar-cane leaf, which has a life of approximately seven years although not continuously watertight during that time.

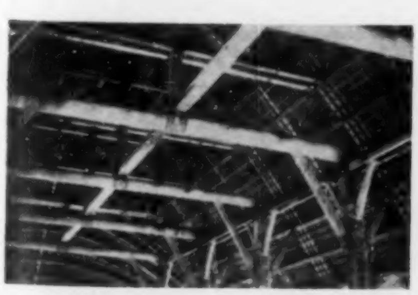
Naturally, prior to undertaking the design it was necessary to examine carefully numerous existing long houses to determine correct proportions, characteristic details, the true shape of the roof, the proper design for the elaborate tying with sennit, and to analyze the structural weak points commonly causing failures in native buildings.

STRUCTURAL WEAKNESSES CORRECTED IN LIBRARY DESIGN

In the native construction, the supporting columns are buried from 3 to 4 ft in the ground, and the house is largely dependent upon this penetration into the soil for security against overturning. Destruction of Samoan houses, during the high winds and hurricanes that frequently occur there, was reported to be caused primarily by failure of these supporting columns at the base, probably due to dry rot, and inadequate securing of the end sections to the center part since the curved ribs had no contact with the longitudinal purlins. It was naturally important to correct these weaknesses. Creosote treatment for the columns was discarded as not sufficiently permanent. Burying them in concrete no doubt would have given greater support but there again deterioration would have progressed and replacement would have been impracticable. It was decided therefore to build a small spread footing for each main interior column and a continuous foundation wall to carry the bases for the exterior columns. Also, all exterior columns were anchored with $^1/_2$- by 2-in. iron strips in pairs bolted through each column, the base of which was treated before being set in place. Each exterior column was stood on a small individual pedestal to maintain similarity in appearance with the Samoan construction. Not only did this method provide protection against deterioration, but also effected excellent resistance against overturning. The curved ribs of the end sections were secured to the longitudinal purlins of the middle section by mortised joint, doweled, and a new wrapping was designed (Fig. 3).

Shortly after it was decided to use this type of construction, an exact scale model of the structure was built, to stimulate the interest of the Samoans and to serve in demonstrating construction methods to the native builders. A wooden base was substituted for the concrete footings, but in most other details the model is an exact duplicate of the library itself, at a scale of $^1/_2$ in. to the foot. Woods employed in the building were employed in the model for identical parts. This model was on exhibit at the New York World's Fair but was withdrawn in favor of placement in the Smithsonian Institution, Washington, D.C., where it bears witness to the unusual features and broad scope of the undertakings of the officers of the Civil Engineer Corps.

In several of the preliminary meetings with members of the Samoan builders' guild the increased use of pegs or dowels was extensively discussed and agreed upon. In the exterior wall structure the Samoan develops but little if any structural utility. By the use of dowels, this section was given a definite structural function, that of actually supporting the overhang of the roof and of resisting the tendency to uplift and to overturning during high winds. The model was of great help in this phase of the design and also in working out the details of erection procedure, especially the new falsework employed in lieu of the elaborate wigwam type used by the Samoan. The practicability of setting the curved members of the end sections by a rotating template such as is used in dome construction was also found by model study. In many other ways the building of the model proved a fine investment.



INTERIOR ROOF DETAILS

MAIN COLUMN WITH KNEE BRACES AND CROSS CONNECTIONS

For more than two months, meetings of interested Samoans were held several times a day to discuss in great detail the various elements of the structure and the methods of erection. A thorough knowledge of the Samoan names of house elements was essential. These names are not widely known except to the guild. All types of individuals became interested, including the native preachers, the Latus and their assistants, Samoan chiefs, and distinguished visitors passing through on steamer days.

It is rightfully stated that the Samoan builder constructs his building from the ridge pole down. As other builders would set a cornerstone, he erects first the main columns—with appropriate ceremonies. Then he fabricates his falsework, which consists of large timbers tied together in wigwam fashion on which to support the ridge pole. With the main cross-beams and temporary king posts in position, the controlling longitudinal purlin resting on the cross-beams is secured in place. Using the ridge pole and this principal purlin as control points, the Latu shapes his roof with a thin strip of cocoanut wood. The main purlins and the roof structure are then erected on temporary shores held in position rather precariously and necessitating great care in the preliminary stages of the work to avoid disturbing them. When the roof mat is essentially complete, overhanging from the collar beam, the Samoan builder must insert his cross struts, a construction sequence which naturally cannot give equal distribution of load to the principal supports even with the most careful fitting. Likewise, the curved ribs of the end sections are held by a great many shores or braces until the entire section can be bound into a rigid mat. The round wall plate is then supported from the overhanging roof, and finally the exterior columns are erected. Appropriate ceremonies are observed at the completion of the various sections of the building, and only one operation progresses at a time.

Several details in the Samoan design should be mentioned. It required many weeks of research to determine the reason for some of these, although they are simple in principle when once understood. For instance, members of the guild stated that the principal longitudinal purlin and the other main purlins below it had to be curved approximately two inches outward at the

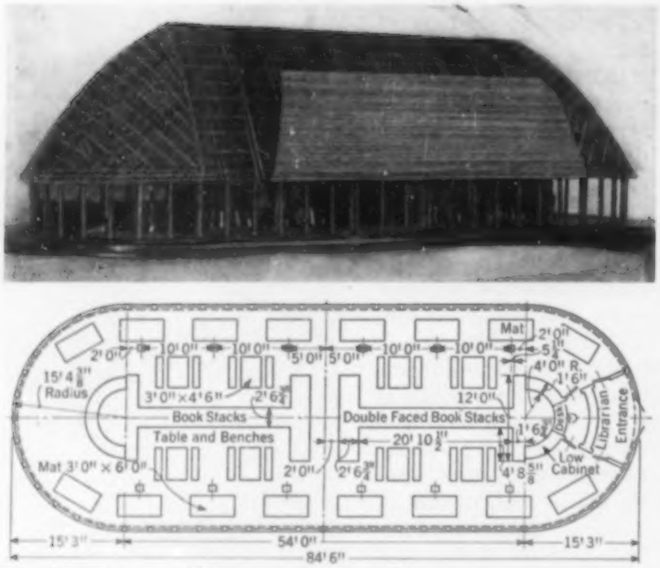


FIG. 1. GENERAL FLOOR PLAN OF THE LIBRARY AND, ABOVE, THE SCALE MODEL OF THE COMPLETE STRUCTURE

center. For some time all that the Samoan builders would say in answer to our questions was that this was a time-honored custom handed down through their guild. Finally, however, a prominent Latu stated that if these members were built straight they would give the roof a hollow appearance. Naturally, the various individual members could not be constructed perfectly straight by the method of hand hewing used, and with each section slightly waved, there would actually appear to be hollows when all the sections were set to a straight line. By setting the sections on a slight outward curve, this impression would be corrected and the roof, when covered by heavy thatching, would appear straight. Another example of the attention the Samoans give to detail is the method adopted to create the effect of great height in their long houses by diminishing the size of the cross struts as they go upwards. This is a basically good architectural principle and is instinctively followed by this fine group of craftsmen.

SAMOAN CONTRIBUTIONS TO THE WORK

To secure the native timber and sennit required for construction the Governor appointed a committee consisting of the Superintendent of Public Works as chairman, and seven Samoans—the three district governors, and, pursuing characteristic Samoan culture, two county chiefs, and two high talking-chiefs. According to the decision of the committee, the Eastern District provided material for one-half of the building and the Western District provided that for the other half, while the Manu'a District supplied the sennit. According to the original estimate, 39,000 fathoms of sennit would be required, but there was no precedent on which to base this estimate and the final count was 49,000 fathoms (about 56 miles) in the completed structure. The cost of transporting the materials was paid from the funds collected for the building, but the materials themselves were supplied as a contribution from the Samoan people, divided equitably among the villages.

When the bulk of the material had either been delivered or arranged for, the committee's enthusiasm had grown to such an extent that they looked for other work to do in assisting the chairman. Subsequent conferences brought up the possibility of utilizing the native builders, the Latus, in wrapping the sennit and placing the elaborate ties of this cord at the joints. It was felt that such procedure would not only result in representative craftsmanship from the various districts, but would also promote the interest and education of the Latus in improved structural design, methods of erection, and economy of construction. Accordingly fifteen Latus—five from each district—were delegated by the respective governors. Incidentally the greatest of care is exercised in wrapping the sennit to see that no turns or twists are introduced that will disturb the design. Such twists, according to the Latus, would be especially noted by visiting members of the guild as a mark of poor craftsmanship.

By comparison with the Samoan method of erection previously described, the radical changes introduced in construction details and order of work may be appreciated. The first step was of course to erect the main columns on the bases previously prepared for them. To the tops of these columns the main plates were temporarily secured with dowels so that the cross-beams could be set in place and the three members of the joint tied together with the sennit simultaneously. In the Samoan method, the main columns and the main plates are wrapped with sennit before the cross-beams are placed. The method used, in addition to giving a stronger and more compact joint, eliminated the possibility of having timber resting on sennit. Next the exterior columns were set in place and the wall plate carefully alined on top of them, not only to simplify erection but to reduce the amount of staging required. Ties between the main columns and adjacent wall posts about 18 in. below the wall plate served as supports for planks for the staging.

Following the placing of the longitudinal tie, the center bridging was placed, but instead of the elaborate falsework used by the Samoans, crude slabs from the mill were employed. This method, devised while constructing the model, probably constitutes the most radical deviation from the Samoan method. Besides conserving material it facilitated the accurate placing of the principal roof members and served as staging throughout the erection. The king posts were placed and finally alined after the ridge pole was set. The

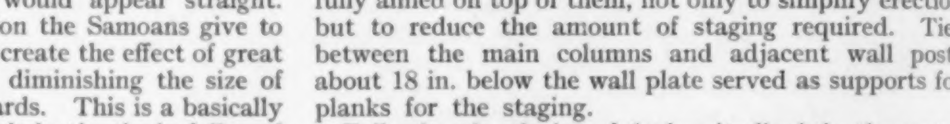


FIG. 2. LONGITUDINAL AND TRANSVERSE SECTION

roof shape was quickly determined, as it had been graphically analyzed and referenced in the field from predetermined coordinates. A thin curved piece of cocoanut wood bent around the nails driven in the main ridge pole, struts, main beam, and wall plate served to check the roof shape. This required about twenty-five minutes as compared with three or four days in the Samoan method. Immediately following this step the securing of approximately 22 miles of $^1/_2$-in. diameter roof members was started.

While work proceeded on the center section, erection of the curved end sections was started. Arch centering supported on the end top struts and the center wall posts of the end section were placed on the center line and at 45 deg therefrom. Step supports were then superimposed on this centering at predetermined intervals and elevations, and the curved members and small rafters were placed.

Considerable interest was shown by the descendants of the ancient builders' guild in the details used to strengthen numerous joints. A dowel through the main plates into the main column, a dowel in the head of the main column to support the main beam, the use of pins through the longitudinal tie into the main beam and the king post, the securing of the wall posts at the top with pins, the resistance to uplift by the use of dowels through the wall posts into the wall plates, and the joining of the ribbed end arches with the main purlins (Fig. 3) all created unusual interest and no little amazement.

MISCELLANEOUS DETAILS OF DESIGN

Thatching the roof with shingles presented a unique problem. Redwood shingles were purchased from the States and cut on the band saw to give an irregular bottom edge. The shingles were then placed by lining up the tops rather than the bottoms. Because of the openwork type of roof, without ceiling, it was highly desirable to use a thatching method rather than nailing strips. A method very similar to the attaching of sugar-cane thatch was worked out, using thin strips of zinc and galvanized wire clamps.

In installing the floor the endeavor was made to create the same effect as the usual Samoan long house, which has coral throughout. A coral terrazzo was developed that proved fairly successful. No side walls are employed. Protection from the elements is provided by curtains and screening. The two H-shaped bookstacks down the center of the straight section protect the books with sliding glass doors and heating elements. Indirect electric lighting was installed throughout, except over the reading tables, where lamps were suspended from bamboo poles resting on top of the bookstacks. These have shades formed to simulate a small Samoan round house.

A novel protection from crawling insects was provided by surrounding the entire building with a narrow, shallow moat containing running water taken from an adjacent stream. Similarly, a narrow trench, completely disguised beneath the baseboard, was installed around the bookcases to carry a small amount of running water.

Throughout the work the Latus showed a most cooperative spirit. They appeared keenly interested and after a few false starts were very willing to coordinate their efforts to accomplish the task as designed. When it is considered that Latus do not customarily work together, and that many of them have their own secrets which they are reluctant to discuss, their attitude toward the project is seen to be truly remarkable.

Work on the foundations was started in February 1938, and work on the superstructure on April 1. Thirty-nine working days thereafter, the building was completed and ready for dedication. The normal erection time for a Samoan long house of similar dimensions is from fourteen to sixteen months.

In order that the dedication ceremony, with its legendary presentation of "fine mats," might be entirely in keeping with Samoan tradition, its details were left entirely to the judgment and planning of the Samoan members of the committee. Incidentally, the ceremony contained a great surprise for the writer, who was made a member of the Samoan builders' guild with the title of chief Latu. This is the first time that the guild has conferred such an honor on anyone not a native Samoan. The title of "Asofausia" was later designated.

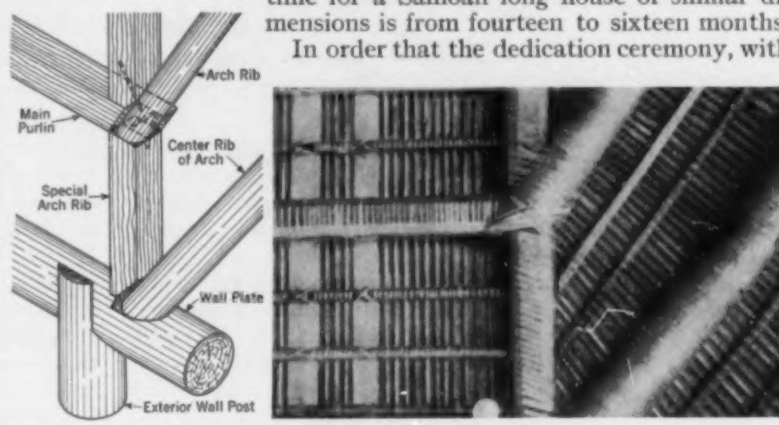


FIG. 3. METHOD DEVISED TO TIE MAIN PURLINS, ARCH RIBS, AND SPECIAL ARCH RIB TOGETHER TO TAKE VERTICAL THRUST; ALSO TO INCREASE END BEARING OF ARCH RIB ON WALL PLATE

Photograph at Right Shows Part of Same Connection Wrapped with Sennit. In the Native Construction the Only Connection Here Is That Provided by the Roof Mat

MANY BENEFITS DERIVED FROM THE WORK

In conclusion it is appropriate to record the benefits derived from this work. Of course the main purpose was to provide a library for the Samoan people, and unquestionably there existed a great need for such a cultural center. But many other advantages have been secured. The educational value to the Samoan builders has been manifested by the many comments of its members and by the fact that similar buildings have actually been undertaken, employing several of the structural features proposed and carried out on the library construction. One of the most skillful of the Latus requested employment with the Public Works Department following completion of the structure. He was accepted and has proved himself an industrious worker with a keen aptitude for the use of modern tools. If present plans are carried out for the construction of all public buildings in Samoan architecture by the government, the training of this Latu will serve a fine purpose in continuing the use of the improved structural details worked out on this project.

No doubt the greatest benefit of all may be accredited to the working together of many people in many villages. This is the first time that the efforts of all the people of American Samoa have been coordinated to erect a public monument, and also the first time that the builders of the ancient Samoan guild have been brought together to create a structure in the style of architecture devised by their ancestors.

Henri Pitot, Pioneer in Practical Hydraulics

His Invention, Still in Use Today, Is One of Few That Can Be Credited Indisputably to a Single Individual

By Richard Shelton Kirby

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MUCH of the technique of modern hydraulicians originated with the Italians and French between two and three centuries ago. Among these pioneers was one whose name is rightly a household word among engineers today—Henri Pitot.

His immediate forerunners in the Italian group included two pupils of Galileo, Benedetto (Antonio) Castelli (c. 1577–c. 1643) and Evangelista Torricelli (1608–1647). Castelli was the first to reason clearly that velocity multiplied by cross section gives quantity of flow, while Torricelli proved that discharge through an orifice varies with the square root of the head. Domenico Guglielmini (1655–1710), the next on the scene, was a voluminous writer and largely a theorist. While his contributions are in the main basic, he erred in concluding that velocity in a stream increases from the surface down. Following him came Giovanni Poleni (1685–1761), scholarly engineer and experimental hydraulician, who worked fruitfully on orifice discharge.

The French group of the period is led by Pierre Varignon (1654–1722), better known for his contributions to the theory of statics. And in the next generation came Pitot, who belongs high on the roll of practical hydraulicians. Contemporaries of his were the Swiss theorists Léonard Euler and Daniel Bernoulli.

WORK WITH THE ACADEMY AND IN LANGUEDOC

Henri Pitot was born at Aramon, in southwestern France, May 29, 1695, of parents in comfortable circumstances, and died in his native town, December 27, 1771. As a lad he was decidedly averse to study, but at twenty, after glimpsing for the first time the inside of a treatise on geometry, he suddenly developed an avid and insatiable interest in the mathematical and physical sciences. At twenty-three he went up to Paris, where he spent more than twenty years. At first he was a pupil of René-Antoine de Réaumur (1683–1757), chemist and natural philosopher. Réaumur turned the ambitious young man loose in his library and laboratory, and under his tutelage Henri gradually acquired a name for himself and membership in the Academy of Sciences. For years he served the Academy as what we should describe as one of their research associates under salary.

In 1740 Pitot agreed, after much coaxing, to leave Paris and go down to the Province of Languedoc as director or superintendent of the Canal du Midi. At the same time he was commissioned to drain their extensive and troublesome marshes. He spent the remaining thirty years of his life in that region, not far from his boyhood home, and left there many monuments to his genius. Among these the best known to us are the highway bridge which he cleverly built close up against the Pont du Gard near Nîmes, without materially marring the beauty of the old Roman structure [shown on this month's Page of Special Interest], and the Montpellier aqueduct, with its lovely St. Clément aqueduct-bridge. An inscription on the former [shown on this page] is one of the earliest to commemorate the work of an engineer. The original was destroyed during the French Revolution (probably on account of the word *Regia*) but was shortly replaced.

AQVAEDVCTVM
STRVXERANT
ROMANI
PONTEM ADDIDIT
OCCITANIA
ANNO MDCCXLV
CVRA D. HENR. PITOT E REGIA SCIENTIARVM ACADEMIA

Pitot's portrait has only recently come to light, and is reproduced here by courtesy of the Académie des Sciences, to which goes the credit for its discovery at the Paris home of a descendent, M. Léonce de Neuville, Ingénieur en chef du Génie maritime. Pitot is described as of slight physique, reticent in speech, modest almost to the point of shyness, but altogether a likable and friendly soul.

He was connected with the Academy in some capacity or other for nearly half a century. His contributions up to the time he became a civil engineer were many. They covered not only practical problems in hydraulics, hydromechanics, and theory of structures, but also geodesy, astronomy, mathematics, and (later) sanitary engineering. His only full-size book, on the theory of the handling of vessels, was translated into English and used for years in the British navy as a text; it brought him membership in the Royal Society of London.

In a paper published in 1737, Pitot comments almost in the style of a modern consulting engineer or teacher on a proposition to furnish water to the city of Paris at a fabulously low figure. It seems that some enthusiast had offered to pump 10,000 hogsheads per day to an elevation of 130 ft, with only a moderate amount of power. Pitot concluded that the power necessary would be equivalent to that of 1,500 men or of 200 horses, an early use of a term equivalent to horsepower. He proceeds to explain that:

"In all machines there are four quantities to consider.

"The first is the power or motive force that moves the machine; this force may be derived from men or from horses, or from the impulsion of a fluid, as water, wind or even fire.

"The second quantity is the speed, or the path that the motive force moves in a given time.

"The third is the force of resistance, or the weight moved by the machine.

"And the fourth is the speed or the path that the weight moves in a given time.

"Of these four quantities the product of the first two is always equal to the product of the last two—these products being the quantity of motion."

Engineers of our day will find much of interest in the paper Pitot presented on November 12, 1732, entitled "Description of a Machine for Measuring the Velocity of Running Water and the Speed of Vessels." His "machine" we still call the Pitot tube. A much condensed translation of this paper follows.

After noting that the banks and beds of rivers are subject to frequent changes due to currents, and that it is often important to be able accurately to estimate the velocity at various points, he proceeds:

"The only practical means up to the present for measuring these velocities has been to throw into the

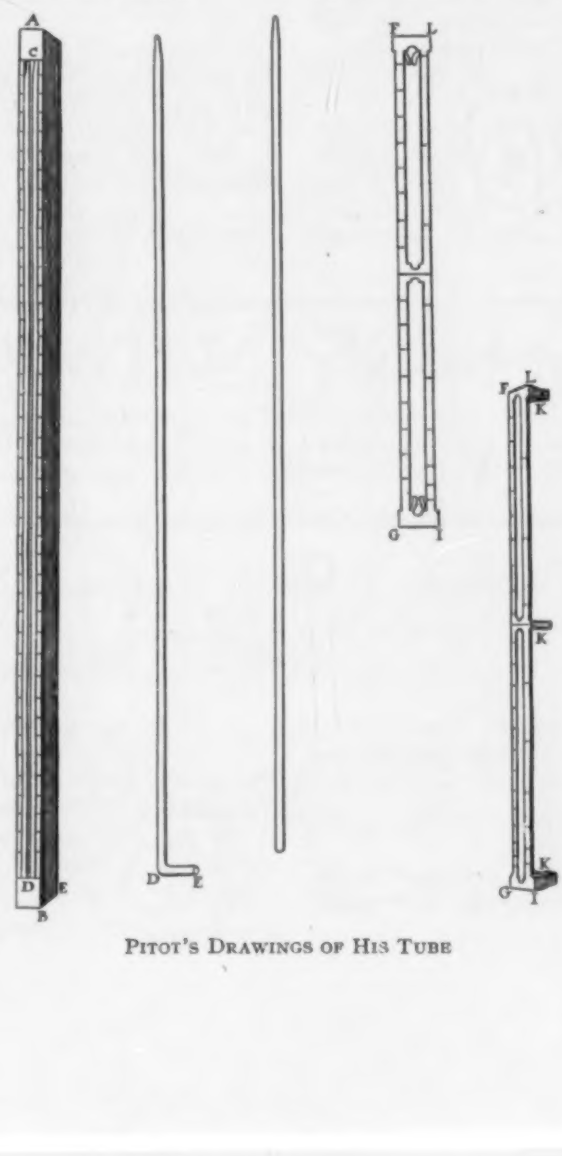
Vitesse de l'Eau.		Hauteur des Chutes.				Vitesse de l'Eau.		Hauteur des Chutes.			
Pieds.	Pouces.	Pieds.	Pouces.	Lignes.	Points.	Pieds.	Pouces.	Pieds.	Pouces.	Lignes.	Points.
6	1	...	7	11	1 13/14	9	1	1	5	8	1 13/14
6	2	...	8	1	7 1/7	9	2	1	6	0	0 6/7
6	3	...	8	4	5 3/14	9	3	1	6	4	0 3/14
6	4	...	8	7	1 5/7	9	4	1	6	8	0
6	5	...	8	9	10 1/2	9	5	1	7	0	0 3/14
6	6	...	9	0	7 3/7	9	6	1	7	4	0 6/7
6	7	...	9	3	5 5/14	9	7	1	7	8	1 13/14
6	8	...	9	6	3 3/7	9	8	1	8	4	3 3/14
6	9	...	9	9	1 13/14	9	9	1	8	4	5 3/14
6	10	...	10	0	0 6/7	9	10	1	8	8	7 5/7
6	11	...	10	3	0 13/14	9	11	1	9	0	10 1/2
7	0	...	10	6	0	10	0	1	9	5	1 5/7
7	1	...	10	9	0 3/14	10	1	1	9	9	5 3/14
7	2	...	11	0	0 6/7	10	2	1	10	1	9 3/7
7	3	...	11	3	1 13/14	10	3	1	10	6	

A Portion of the Table Pitot Prepared for Use with His Tube

current a piece of wood or a ball of wax and to measure the path traversed by either in one or several minutes.... [This method has, he observes, so many obvious limitations that it may be dismissed as unsatisfactory.]

"The question of ascertaining whether the velocity near the bottom is greater or less than that at the surface is a curious one and has often divided the opinions of scientists; some argue that because the water lower down is pressed by that higher up, it will be forced to run more swiftly. And besides —since velocity is proportional to fall, the lower particles, being at a greater depth with respect to the source, ought to flow faster.... [Messrs. Guglielmini and Varignon, he says, have speculated along these lines and arrived at an erroneous conclusion.]

"As opposed to this view, one may note the quantity of friction against the banks or bed of rivers. It is true, as I have demonstrated in a memoir in 1730, that this quantity of friction is tremendous, and it is fortunate that such is the case, for without friction, Streams and Rivers would not be navigable. . . . If one should compute . . . the velocity that Rivers ought to have according to their slope, if friction were neglected, one would always find this to be twenty, indeed often thirty times their actual velocity. . . .



Pitot's Drawings of His Tube

It is natural to think that particles near the bottom are more retarded than those at the surface. All these questions, curious and useful as they are, can be settled in the field with great facility by means of an instrument which I propose, and whose operation is as simple as that of plunging a rod into the water and drawing it out again. By this machine the velocity at any desired depth may be accurately measured.

"*Description of the Machine.* *AB* is a wooden Rod in the shape of a triangular prism; midway in one face is cut a groove wide enough to hold two tubes of clear glass; one Tube bent to a right angle at *D*, the lower portion *DE* passing out through an opening [cut through the sharp edge]. . . .

"The face *CD*, in which the Tubes are set, is divided into feet and inches. *FGIL* is a sliding Rule of copper, slit so as to render the Tubes visible for nearly their entire length. One side of the Rule is divided into feet and inches for the heights of fall of water, the other side into feet and inches for velocities corresponding to these heights. It is kept in place by copper lugs which surround the Rod. . . . [And there are three clamp screws, *K*.]

"The first Tube being bent at a right angle, and the second being straight, if the Machine is put into still water, the water will rise to its level in both Tubes. But in a running stream it will rise in the first Tube to the height relative to the force of the current, while in the second Tube it will remain at its level."

Pitot then explains how to use the tube. Although nothing, he says, could be simpler, he nevertheless gives minute practical directions for inserting it to any desired depth and rotating it gently until the water rises to its highest in the bent tube. He then relates how in using the tube under various bridges along the Seine he found that the velocity was practically always greatest at the surface, as he would have expected. Under one of the arches of the Pont Neuf, for example, he found the velocity 4 ft 3 in. per sec at the surface, 4 ft 0 in. at 1 ft down, 3 ft 9 in. at 2 ft, and 3 ft 6 in. at 3 ft.

He next proceeds to what amounts to a discussion of the formula $V^2 = 2gh$, without, however, giving the formula directly. He starts with a falling body which, he says, in the first second falls 14 ft and acquires a velocity of 28 ft a second. Similarly water issues from an orifice 14 ft below the surface at 28 ft a second. Multiplying the height by 4 doubles the velocity, and so forth. Briefly he concludes that "as the square root of 14 is to 28 so will the square root of the given height be to the velocity sought" which (if $g = 28$) gives the formula. He credits Varignon (probably his friend) with having laid down the basic principle that velocities are proportional to the square roots of heights; perhaps Pitot was wrong in this. One hesitates

to take issue with the late Clemens Herschel, scholar that he was, on anything. But here is obviously the formula, which Herschel, in "Explanatory Chapter 6" of his *Frontinus and the Water Supply of the City of Rome*, insists was first established by the Bernoullis in 1737, five years later even than the date of Pitot's paper.

Pitot's table, a portion of which is shown herewith, gives the velocity-heights for velocities up to 12 ft per sec. His units, *pieds* (feet), *pouces* (inches), *lignes* (lines), and *pointes* (points) are in the duodecimal system, which we and the English have partially (but by no means altogether) discarded.

A study of the table will bring out two interesting questions. Consider first that a foot, to Pitot, usually meant a Paris foot, about 12.78 English inches. The value of g had been accurately established years earlier, by Huygens, who died the year Pitot was born. Since Pitot must have been familiar with Huygens' work, why did he assume g to be 28 instead of 30.3, which would be its value in Paris units? It is barely possible that Pitot, brought up in southern France, reverted unconsciously to the *pied de ville* (13.484 English inches), the foot indigenous to that locality, instead of the *pied de Roi* of Paris.

Second, it is obvious to anyone who is not too closely wedded to our decimal system that the tabular heights are the velocities squared divided by 56. And, in the face of all this, why did Pitot let his love for mathematics run away with him, so that he tabulated heights to the nearest ten-thousandth of a foot?

Photo Giraudon

RECENTLY DISCOVERED PORTRAIT OF HENRI PITOT
Reproduced by Courtesy of the Académie des Sciences, Paris

To continue with another quotation from his paper:

"The idea of this Machine is so simple and so natural, that the moment it came to me, I ran down to the river bank to make a first trial with a simple glass Tube, and the effect corresponded perfectly with my conviction. After this first trial I could not imagine how anything at once so simple and so useful could have escaped the many accomplished men who had written or experimented on the movement of water. I have since searched as far as I could in all the Treatises on Hydraulics I could find to see if absolutely no one has spoken of it, and if my idea was indeed entirely novel." [He apparently so concludes, although he avoids making any direct assertion.]

The paper closes with an explanation of the use of his tube for determining the progress of vessels, illustrated by a recital of his own experience in sailing a measured three miles or so (2,300 *toises*) in half an hour, up the river Seine, before a spanking breeze.

If Pitot were living it is interesting to speculate as to the satisfaction he might derive from observing the many applications of his simple and natural "Machine"; how, with certain additional refinements its usefulness is, after 200 years, being constantly expanded. One might observe, further, that this is one of the few inventions in history that in the beginning was clearly and indisputably the work of one man.

ENGINEERS' NOTEBOOK

This department, designed to contain ingenious suggestions and practical data from engineers both young and old, should prove helpful in the solution of many troublesome problems. Reprints of the complete department, 8½ by 11 in., suitable for binding in loose-leaf style, are available each month at 15 cents a copy.

Simple Formula Aids in Running Spirals

By C. W. CHARLESON

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THE following simple formula will be found convenient in computing deflections for backsights or foresights from any intermediate point on a spiral.

Let A = number of the spiral point for which deflection is to be computed

B = deflection in minutes to set first chord point running forward (constant for any given spiral)

C = number of point over which transit is set.

Then $AB(C + A)$ = deflection in minutes to set point A. B equals $LD/10n^2$ where L is the length of spiral in feet, D, the degree of curve expressed in degrees and decimals, and n, the number of subchords in the spiral.

Example: Compute deflections for a 360-ft spiral joining a 4° curve using 12 subchords.

$$B = \frac{360 \times 4}{10 \times (12)^2} = 1'$$

Suppose we run in the spiral as far as Point 4 with the transit set at Point 0. Deflections running forward vary as the square of the number of the chord point, but they can also be obtained from formula $AB\ (C + A)$. Thus

For chord Point 1, $1 \times 1\ (0 + 1) = 1'$
For chord Point 2, $2 \times 1\ (0 + 2) = 4'$
For chord Point 3, $3 \times 1\ (0 + 3) = 9'$
For chord Point 4, $4 \times 1\ (0 + 4) = 16'$

The transit is now moved up to chord Point 4. Backsighting on chord Point 0 we have, as starting deflection, $0 \times 1\ (4 + 0) = 0$, because $A = 0$ and $C = 4$. To set Point 5 we have $5 \times 1\ (4 + 5) = 45'$, and to set Point 9 we have $9 \times 1\ (4 + 9) = 117' = 1°\ 57'$.

Move transit to Point 9 and backsight on Point 4. To get the starting deflection for Point 4 (that is, the backsight setting for the vernier) we have $4 \times 1\ (9 + 4) = 52'$, and to set Point 12 (end of spiral) we have $12 \times 1\ (9 + 12) = 252' = 4°\ 12'$. Turning the vernier to read $4°\ 12'$, the line of sight will be on Point 12.

Move transit to Point 12. For the backsight on the last hub (Point 9), we have $9 \times 1\ (12 + 9) = 189' = 3°\ 09'$; and to turn the tangent to spiral at Point 12 the deflection is $12 \times 1\ (12 + 12) = 288' = 4°\ 48'$. If desired, the difference of these angles may be set up, so that the vernier will read zero at the beginning of the circular curve.

The formula will also apply to intermediate chord points on a spiral. Suppose the transit is set up at Point 7.3 and we wish to backsight on Point 5.2 and set Point 9.8. Applying the formula, $5.2 \times 1\ (7.3 + 5.2) = 65' = 1°\ 05'$ (for backsight) and $9.8 \times 1\ (7.3 + 9.8) = 167'.58 = 2°\ 47'.58$ (for foresight).

Setting up at intermediate points will not be frequent, and the formula here given may be used conveniently where tables are not at hand. It can also be used as a quick check on other computations.

Simplified Design of Box Culverts by Moment Distribution

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By making a few practical assumptions, the design of single and double box culverts becomes extremely simple. First, the top and bottom slabs are taken equal to each other, and the side walls are likewise assumed equal. Secondly, a uniform equal vertical loading is applied to the top and bottom slabs, and a uniform equal lateral loading is applied to the side walls.

The corner moments are determined by formulas developed by moment distribution. The positive moments, the points of inflection, and shears are then readily obtained by statics.

The following nomenclature is used throughout this article:

l = width center to center of culvert walls
h = height of culvert, center to center of top and bottom slabs
w = uniform equal vertical loading on top and bottom slabs, in lb per sq ft
p = uniform equal lateral loading on side walls in lb per sq ft
M_a, etc. = corner moments in lb-ft per ft length of culvert
A_1, etc. = shear at point A in member 1, etc., per ft length of culvert
M_t = fixed end moments in top and bottom slabs $= \dfrac{wl^2}{12}$
M_s = fixed end moments in side walls $= \dfrac{ph^2}{12}$
M_x = moment in culvert at distance x from a chosen point of reference
d_t = distribution factor for top and bottom slabs
d_s = distribution factor for side walls

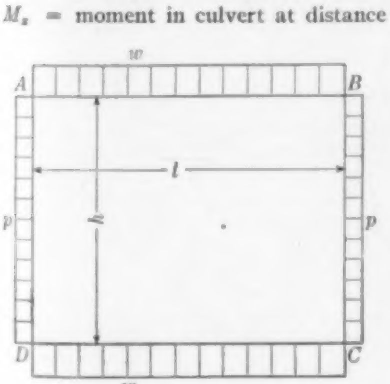

FIG. 1

In Fig. 1 is shown the load diagram for the single box culvert. Figure 2 shows the balanced fixed end moments due to the top and bottom slabs being loaded. The balancing of moments is carried sufficiently far to identify the geometric series whose sum for an infinite number of cycles is the true theoretical value of the corner moments. The following equation gives such a result, showing the positive value of the corner moments for loading on the top and bottom slabs. (Moment distribution, of course, gives at each corner two moments alike in quantity but differing in sign. Both are, however, negative in respect to steel reinforcement.)

$$M_a = M_b = M_c = M_d = M_t d_s \quad \ldots\ldots\ldots\ldots [1]$$

Similarly, for lateral loading on the culvert:

$$M_a = M_b = M_c = M_d = M_s d_t \quad \ldots\ldots\ldots\ldots [2]$$

The sum of Eqs. 1 and 2 gives the corner moments of the culvert for vertical and horizontal loads both acting:

$$M_a = M_b = M_c = M_d = M_t d_s + M_s d_t \quad \ldots\ldots\ldots [3]$$

The positive moment of the top and bottom slab is a maximum at the midpoint and its value is:

$$M = \frac{wl^2}{8} - M_a \quad \ldots\ldots\ldots\ldots [4]$$

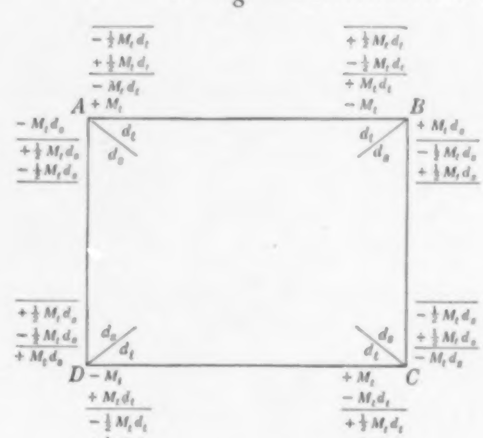

FIG. 2

Shears A_1, A_2 . . . , are given by:

$$A_1 = B_1 = C_1 = D_1 = \frac{wl}{2} \qquad [5]$$

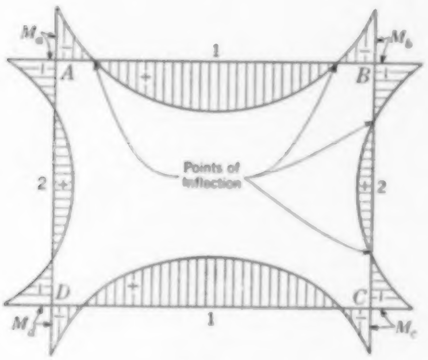

FIG. 3

The points of inflection, measured to the right from A or D, are obtained by setting the following equation equal to zero:

$$M_x = A_1 x - \frac{wx^2}{2} - M_a \qquad [6]$$

Values for the maximum positive moment, the shears, and the points of inflection are found in a like manner for the side walls. Figures 3 and 4 show, respectively, the moment diagram and the shear diagram for the single box culvert.

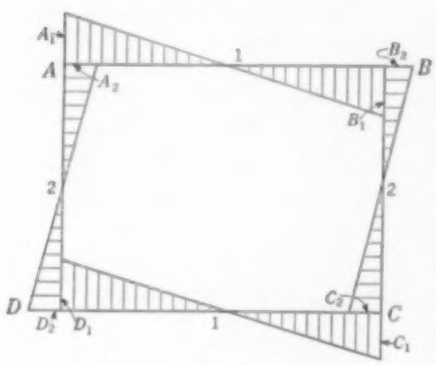

FIG. 4

The load diagram for a double box culvert is shown in Fig. 5, and the balanced fixed end moments due to the top and bottom slabs being loaded, in Fig. 6. By going through the procedure used for the single box culvert, it can be shown that the corner moments for vertical loading on the culvert are:

$$M_a = M_c = M_d = M_f = \frac{M_t d_s}{2 - d_s} \qquad [7]$$

$$M_b = M_e = M_t \frac{3 - 2d_s}{2 - d_s} \qquad [8]$$

Similarly, the corner moments for lateral loading on the culvert are:

$$M_a = M_c = M_d = M_f = \frac{2M_s d_t}{2 - d_s} \qquad [9]$$

$$M_b = M_e = -\frac{M_s d_t}{2 - d_s} \qquad [10]$$

and the corner moments for vertical and lateral loading both acting are:

$$M_a = M_c = M_d = M_f = \frac{M_t d_s}{2 - d_s} + \frac{2M_s d_t}{2 - d_s} \qquad [11]$$

$$M_b = M_e = M_t \frac{3 - 2d_s}{2 - d_s} - \frac{M_s d_t}{2 - d_s} \qquad [12]$$

Shears for the top and bottom slab are given in the following equations:

$$A_1 = C_1 = D_1 = F_1 = \frac{wl}{2} - \frac{M_b - M_a}{l} \qquad [13]$$

$$B_1 = E_1 = \frac{wl}{2} + \frac{M_b - M_a}{l} \qquad [14]$$

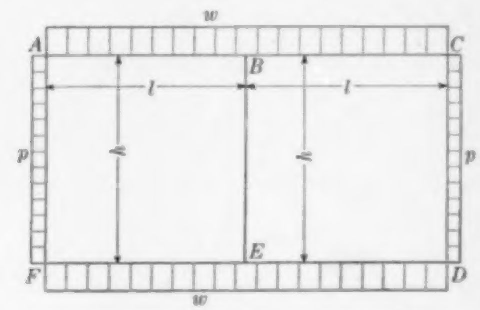

FIG. 5

The points of inflection, measured to the right from A or F, and from the left from C or D, are given when the following equation is set equal to zero:

$$M_x = A_1 x - \frac{wx^2}{2} - M_a \qquad [15]$$

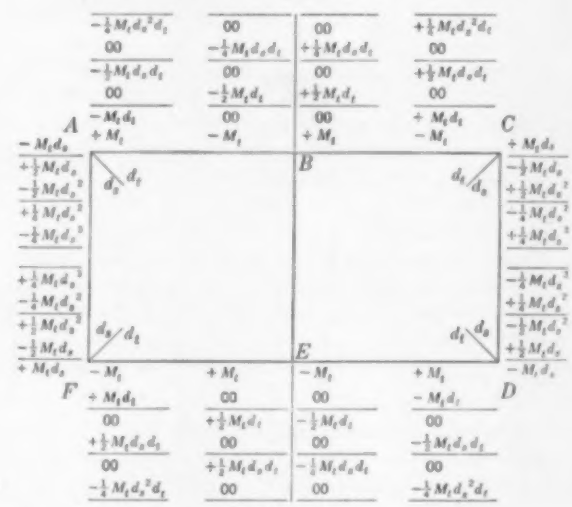

FIG. 6

By substituting the average value of the distances to the points of inflection into Eq. 15, the maximum positive moment is obtained for the top and bottom slabs.

The values for the maximum positive moments, the shears, and points of inflection are similarly obtained for the side walls. Figures 7 and 8 give the moment diagram and the shear diagram, respectively, for the double box culvert.

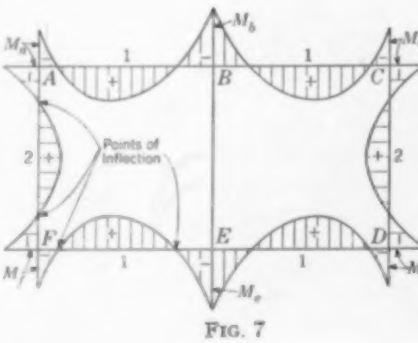

FIG. 7

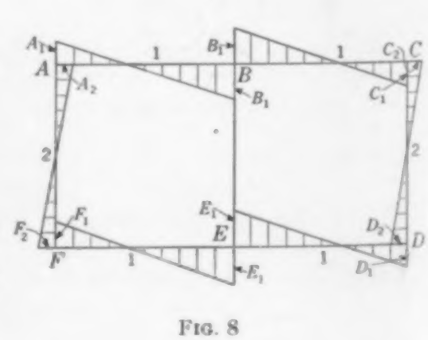

FIG. 8

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Building Code Enforcement

To the Editor: Mr. Laidlaw's article on "A Modern Building Code—Arrangement and Organization," in the June issue, and the subsequent discussion prompt me to answer the question, "Can a building code be enforced?" It will be necessary, first, to consider some prerequisites, the absence of which makes enforcement difficult if not impossible. These are (1) the nature of the code, (2) quality of supervision, (3) efficiency of personnel, and (4) cooperation of the public. The last three of these are interrelated.

Enforcement must be based upon a workable, concise, well-arranged, and simply worded code, which is legally sound and can be upheld in court if need be. The code should be up to date, and should embody the latest engineering information for which there is recognized authority. Provision must be made for amendment when needed. An antiquated code requires so much interpolation when applied to modern problems that it becomes a travesty. Only experts in various branches of the building business, including architects, engineers, contractors, and perhaps dealers in materials, should be appointed. A very common fault in codes is ambiguity due to the incorrect use of English, and many of the difficulties of application arise from this cause. The remedy is to have the code edited by an expert in English. If a code goes too much into detail and becomes in effect a set of specifications, enforcement is made more complicated because eventually there will be a job that does not readily fit the specifications. It is better to confine code provisions to fundamental requirements and to allow the designer as much latitude as possible.

Next in importance to the code itself is the degree of intelligence used in applying it to practical cases. This depends, to a great extent, upon the quality of supervision. The person responsible for enforcement should be one who is fitted for the responsibility by education and experience. The administration—particularly of a large department—should be in the hands of one who has been trained as an architect, or structural engineer, and preferably one whose viewpoint has been broadened by practical experience. This must, of course, be in addition to the usual qualifications for an executive.

In the selection of personnel, which is of primary importance, there are two qualifications that cannot be overlooked. The first of these is technical qualification. The field inspector or plan checker must have enough education and experience so that he can intelligently prosecute the work assigned to him. The second is the individual's temperamental qualifications. If patience and the ability to cooperate, to understand another's problem, and to direct without domineering are lacking, the individual's technical ability may not carry him through. Most of the serious difficulties in code enforcing which have come to the writer's attention have arisen through the absence of some of these qualifications and not through technical mistakes.

Cooperation of the public and the building industry and trades is of such vital importance that without it enforcement would be a failure. To gain this cooperation it is essential to have it known that the code is intelligently and impartially enforced and that it is therefore a benefit to the general public as well as to the building industry.

The department head should be entirely responsible for enforcement. To relieve him of political pressure there should be a legally constituted board of appeals, to which recourse may be had in doubtful cases. On this board there should be representatives of the architectural, engineering, and legal professions, as well as a general contractor. The decision of the board should be final.

It might be said that the foregoing outlines an ideal condition difficult or impossible to attain in practical cases. For several years the writer has been associated with the Department of Building and Safety of Los Angeles County which enforces a building code over an area of about 3,000 sq miles. The code used is the Uniform Code of the Pacific Coast Building Officials' Conference.

From this experience, although it is not claimed that the ideals set forth have been achieved in the absolute, the question, "Can a building code be enforced?" may be truthfully answered in the affirmative with one qualification—if the prerequisites have been supplied.

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Los Angeles, Calif.

Inequalities in Diversion of Gas Tax

To the Editor: Mr. Simpson's editorial, "Is Diversion a Menace or a Myth?" in the September issue, is particularly valuable in that it consists primarily of an unprejudiced analysis of facts. Unfortunately many, if not most, writers on this subject apparently begin with a conclusion and then attempt to marshall evidence to support the conclusion.

The real "menace" of diversion, as I see it, is its unfairness to the individual taxpayer. The diversion of gasoline taxes, which is the usual type, seems particularly unfair.

Presumably taxes should be levied according to ability to pay, or to special benefits received, or according to both. The gas tax, when used for roads, is really a toll of about $^1/_{15}$ cent per mile for each cent of tax per gallon. Thus a tax of 5 cents per gallon is equivalent to a toll of $^1/_3$ cent per mile. As the size or speed of vehicles increases, the toll is automatically increased. The general principle of tolls has been accepted, perhaps for centuries, as being entirely fair, and the fairness of toll collection through gas taxes has been recognized by motorists during the twenty years that it has been used.

The number of miles an individual drives an automobile is not, however, necessarily, or even probably, a measure of his ability to pay general taxes and is certainly not a measure of the benefits he receives therefrom. In fact the chances are that Farmer Green who lives ten miles from town has less with which to pay taxes than Farmer Brown who lives only one mile from town. Therefore it seems grossly unfair to charge Green ten times as much for the general support of government (so far as gas taxes are concerned) as Brown is charged, simply because the former cannot afford to buy a farm near town. It is small consolation to Green, who has to contribute more to general taxes because he is too poor to live near town, to know that, in the state as a whole, less money is diverted than is raised for highway purposes from other sources.

If the tax is five cents a gallon, with two cents diverted, then a salesman making, say, \$2,000 a year, and driving 60,000 miles a year to do it, would pay \$80 a year general taxes, while a man with an income ten times as large, but driving only 6,000 miles a year, would pay \$8.

In spite of the innumerable articles and reports which have been written on the subject of diversion, I cannot recall a single instance in which a writer has claimed that it is fair to tax an individual for general government purposes according to the number of miles he has to drive to make a living.

It has been pointed out that highway investments preclude using the funds for taxable investments and that therefore the taxes foregone are part of the cost of the roads. In Michigan the main support of the state is a sales tax, and a recent ruling makes highway materials subject to this tax. In all states, the highway investments are made in small amounts by many individuals, and there is no assurance that if not so used they would be employed for taxable investments. It seems at least as probable that the highway improvements will increase tax receipts from adjoining land, and in other ways.

R. L. Morrison, M. Am. Soc. C.E.
Professor of Highway Engineering and Highway Transport, University of Michigan

Ann Arbor, Mich.

Studies on the Influence of Forests on Mountain Streams

To the Editor: The systematic and detailed investigations described by Mr. Hertzler, in the August issue, are of great interest to all engineers engaged in the study of water supply and flood control problems. To be useful, the studies must be continued over a considerable period of years, in order to eliminate the effect of the great variations in rainfall and to reveal the effect of change in ground-water storage in succeeding years.

If the forest cover on certain of these areas were denuded after some years of observation, similar observations then continued would be of great importance. Indeed, the importance of such an experiment to a study of the effect of forests on stream flow can hardly be exaggerated. Many attempts have been made to compare stream flow from timbered watersheds with that from other watersheds denuded or partially denuded. In few cases has it been possible to obtain accurate quantitative results, because of variable factors that could not be eliminated or evaluated.

An experiment which would be the reverse of the one proposed might be performed if a portion of the completely denuded land in the Copper Basin could be covered with forest growth. The Copper Basin is unique. In it all vegetable life was killed many years ago by sulfur dioxide escaping from a smelter, and erosion long ago removed all the soil and penetrated deeply into the subsoil. Observations of the stream flow from the Copper Basin in its present condition are of undoubted value for comparative purposes, but the Copper Basin lands are very different from what is ordinarily described as deforested land in the eastern United States.

The comparison that Mr. Hertzler makes between peak rates of discharge for four uniform land-use types takes no account of the variation in the size of the watersheds involved. (Information about watershed area was given in the original paper presented at the 1939 Spring Meeting but, unfortunately, was omitted in the published report.) Actually, the forested areas on which these measurements were made range in size from 4 acres to 1,859 acres, a maximum variation of more than 300 times the size of the denuded areas and from 100 to 200 times the size of the other two classes of land use. The comparison he makes would be of interest if it were confined to watersheds of approximately the same size. Because of the great variation in the size of the watersheds compared in Mr. Hertzler's Fig. 5, the curves are without practical value in predicting flood flows and in designing hydraulic structures.

The great variation in the percentage of the precipitation appearing as runoff on the several Coweeta watersheds, as shown in Mr. Hertzler's Table I, is surprisingly large and might be accounted for by subsurface drainage from one watershed to the other. The effect of subsurface drainage from one area to another could be reduced by using larger areas.

While it is doubtless generally believed that ". . . undisturbed, deep soils of forested areas have a very high infiltration capacity . . .," it is difficult to believe that even such ideal soils could absorb rainfalls as heavy as that in Carter County, Tennessee, on June 13, 1924, when 11 in. fell in 4 hours, or in the Webb Mountain area of east Tennessee on August 4, 1938, when 12 in. fell in 4 hours. In observing the infiltration of heavy rainfalls, care should be taken to distinguish between the "infiltration capacity" of a bed of vegetable litter on top of the real soil and that of the soil itself. Water running on top of the soil under a bed of litter could not be correctly described as "infiltered" water.

The early publication of the complete details of all observations being made in the Coweeta experiment, as well as similar observations in the adjacent territory, will be awaited with great interest by engineers concerned with stream regulation. Only by having on hand the detailed basic data can the best and fullest application be made to water supply and stream regulation problems. The engineer charged with the great responsibility of fixing the necessary storage capacity of a flood control reservoir on a given stream would welcome quantitative data indicating how much the size of the reservoir could be reduced if complete reforestation were afforded on all the available lands in the tributary drainage basin, what the cost of reforestation would be compared to the possible saving in the cost of the proposed reservoir, and how long a period would elapse after reforestation until the full effect of such work would be felt.

Charles W. Okey, M. Am. Soc. C.E.
Principal Civil Engineer
Tennessee Valley Authority

Knoxville, Tenn.

Closing Discussion of Friction in Hydraulic Models

Dear Sir: I am indeed gratified that my brief paper in the June issue of Civil Engineering has attracted discussion. It seems to me, however, that certain of the statements in Captain Thompson's letter in the August issue deserve comment lest they lead to a misunderstanding.

The implication in Captain Thompson's letter (Civil Engineering, August 1939) is that I have neglected the "immutable action of the force of gravity" since my equations give results not in conformance with Froude's law.

The error in such reasoning is apparent when it is remembered that Chezy's equations, on which my derivations are based, are simply and rationally derived by equating gravitational forces to frictional forces.

No argument is advanced in my paper against the proper application of Froude's law. Since this expresses an equality in the ratios of the gravitational and inertia forces in model and prototype, the law finds proper application in model studies of such phenomena as wave action and ship hull resistance. In these cases friction is not one of the predominating forces. When friction forces do predominate, the application of Froude's law would of course "compromise in greater or less degree the reliability of model results," which fact is well demonstrated in Table I of my article.

Thomas DeF. Rogers
First Lieutenant, Corps of Engineers, U. S. Army

Balboa Heights, C.Z.

Engineers and Unemployment

To the Editor: The letter of Arthur B. Foote, M. Am. Soc. C.E., on "Engineers and Economics," in the October issue, is enlightening. Perhaps shoemakers should stick to their lasts and engineers to their profession. However, if a shoemaker were a passenger on a vessel in danger of being wrecked and all able-bodied men aboard were needed to aid the officers and crew in averting the disaster, he would not win commendation by sticking to his last during the critical period, especially if he had no orders for footwear.

Engineers have their fair, or unfair, share of unemployment, which may be a blessing in disguise, as they can use their spare time in reflecting on possible cures for the ills which beset the body politic.

Various groups of citizens are active in trying to improve their economic status in relation to that of other groups, and the system of laws and regulations prevailing at any given time is the result of the pressure exercised by all the different groups. The governing group is the most powerful, but it needs the support of a majority of the voters in the other groups in order to function successfully. The difficulty lies in getting a sufficient majority to agree to such changes as are needed to provide the greatest good for the greatest number.

If the governing group pursues a course which to engineers seems certain to land the ship of state on dangerous shoals, engineers should at least try to point out safer courses.

Winston Churchill, first lord of the British Admiralty, in his book, *Amid These Storms*, says: "In all great business very large errors are excused or even unperceived, but in definite and local matters small mistakes are punished out of all proportion."

Employment is sometimes a trial in more ways than one to both employer and employee. Nevertheless, employers who depend on good business for the protection if not increase of their capital, and employees, who depend for their living on wages or salaries, know that poor business and unemployment are to be dreaded and changed for the better as soon as possible.

Unemployment unfortunately does seem to come more often to those who, for some reason or pretext, are listed as the less competent. It is to an engineer's credit to offer constructive criticism and helpful suggestions to political leaders, and it is to be hoped for the sake of all who are temporarily unemployed that Mr. Foote's letter will stimulate many individuals to think and eventually will lead to concerted action which will result in increased opportunities for suitable employment for those who are capable and eager to render useful service.

Frank S. Bailey, Assoc. M. Am. Soc. C.E.

East Braintree, Mass.

Engineering Students Should Be Carefully Selected

To the Editor: It is encouraging to find so soon in Civil Engineering another article on engineering education—"Professional Standards vs. Mass Production in Engineering Schools," by George C. Ernst, in the September issue. Undoubtedly the quality of engineering education is improving, but Mr. Ernst puts his finger on two serious drawbacks—namely, "the general acceptance of practically all material offering itself for engineering education," including those applicants to whom an engineering education is recommended as an "excellent training for any type of future work," and the generally overloaded schedules of members of the teaching staffs. Not only is it disheartening to instruct students not fitted for or not particularly interested in engineering as a profession, it is also demoralizing for the other students who are seriously considering engineering as a profession.

Although the majority of graduates expect work of an engineering nature after graduation, the number of these actually following other pursuits is large. This fact may be an indication that the engineering schools are doing the work of other schools. Perhaps many of the students properly belong in schools of business administration. Would it not be better for both the schools of engineering and their graduates, if the latter had not been so readily accepted by the schools?

Heavy undergraduate teaching schedules are undoubtedly a deterrent to many superior men who would like to teach. If afforded conditions in which they could teach a graduate class or two, engage in research, or practice the profession of engineering, more of these men might be attracted to teaching. If a school of engineering cannot attract to its staff a good proportion of outstanding men, possibly the conditions under which its staff works should be given consideration.

I am not entirely clear as to what Mr. Ernst had in mind when stating as his third objective of a professional school, "thorough instruction in the technics of the profession, which should be distinguished from mere routine drill in the so-called fundamentals." Most schools of engineering are not purely professional schools, and one of their weaknesses is that they have to teach the fundamentals. They often do this by teaching only the bare essentials as engineering subjects. It seems to me that the student should have his fundamental subjects well in hand before entering a school of engineering—then the school could concentrate on the technics of the profession.

Mr. Ernst advocates as a preparation for an engineering career a five- or six-year course, two years of which are to be spent in the liberal arts. It is a question whether three or four years in a college of liberal arts, followed by two years in a school of engineering would not be preferable. It is my belief that such subjects as strength of materials, thermodynamics, and electrical theory can be taught better as pure physics than as professional subjects. I have observed that the greatest difficulty in applying physics to practical problems is more likely to be an inadequate knowledge of physics than unfamiliarity with the practical aspects of the problem.

William R. Osgood, M. Am. Soc. C.E.
Materials Engineer, National Bureau of Standards

Washington, D.C.

Nationalizing the Railroads

Dear Sir: The writer has read with considerable interest Colonel Wilgus' paper on the "Nationalization of the Railroads," in the October issue. He is in complete accord with the basic outline of remedial measures and is glad to find the paper from the pen of an engineer as distinguished as Colonel Wilgus. With the many "isms" in vogue today the paper could not have commanded the respect and attention it deserves had it come from many others who agree most heartily with the author.

The writer has for some time been greatly interested in the question of public utilities and has felt the need for some such "national authority" for all utilities, if their continued development in the interest of national life is to be assured.

To be sure, there will be raised the cry "that the dead hand of bureaucracy will kill the emulation and initiative that go with profit seeking." But the cry will be loudest from the controlling interests of holding corporations. To these, the suggestions of Colonel Wilgus will be impractical and visionary. To the writer these suggestions are the sanest and surest means of perpetuating and advancing the industries our predecessors labored so hard to found and from which they have reaped rich rewards. The writer can find no sound reason for the contention that governmental control will stifle initiative. To admit that it does would seem to be admitting our inability to govern ourselves.

The distribution of profits may be in ways to which some are unaccustomed, and the amount of satisfactory profit from a public utility may not reach the heights of past experience, but we may well stop to recall the lines:

"Times change, ways of doing things,
Old uses, ways of viewing things."

National boards of transportation, communication, and power would do much towards the stabilization and continued advancement of these utilities.

In conclusion the writer would like to comment briefly on certain paragraphs in Colonel Wilgus' suggestions for congressional legislation.

The special courts for determining the fair value of the utilities, suggested in the second paragraph, and the selection of the personnel of such courts will require even greater consideration than the problems with which they will be confronted. The courts might well consist of boards of professional experts in the utilities fields. The question of fair value should be the subject of greater discussion in professional organizations in order to clarify this vague value.

In the first paragraph is outlined a masterful plan for insuring a competent executive personnel free from party and political domination.

The necessity for immediate action, suggested in the fourth paragraph, is well taken and provided for.

Charlotte, N.C. Allan K. Booth, Assoc. M. Am. Soc. C.E.

Maintenance of Irrigation Canals

To the Editor: The writer has read with a great deal of interest the article by Mr. Dowd, in the October issue, regarding silt problems in the Imperial Irrigation District. Mr. Dowd's statements with respect to maintenance of canals bear out the experience of the writer in connection with his work as general manager and chief engineer of the 80,000-acre Mercedes District in Texas.

Climatic conditions in the Imperial Valley are generally quite similar to those in the Lower Rio Grande Valley of Texas, the growing season extending over the entire year in each region.

On the Mercedes system, the silt-burdened river water was pumped directly from the Rio Grande into a large settling basin, the area of the basin being sufficient to permit the water to slow down sufficiently to remove the silt. The desilted water then flowed by gravity into the canal system. This method was found satisfactory because the settling basin could be maintained at sufficient area to effect proper desilting. The waters of the Rio Grande do not, generally, carry as heavy a silt load as those of the Colorado.

The Mercedes system consists of approximately 425 miles of main canals and laterals, of which some 85 miles were lined with gunite concrete in 1930–1931, under the writer's direction. It was soon found that the lined canals became filled with moss, especially during the hot summer months when little water was used for irrigation. An instance is recalled in which a canal with a capacity of 40 cu ft per sec became so filled with moss that but 4 cu ft per sec could be forced through it.

The method found best adapted to the needs of that district, for the removal of moss, was by first draining the canal and then removing the moss by hand labor, using forks and shovels. This work was done just before the heavy season for watering came, as was also the cleaning of canals of weeds and other growth. All the above work was done by hand labor, which in the particular case, was found to be the most economical method. The average cost per mile for labor, for the years 1934, 1935, and 1936, for cleaning lined canals, was $12.75; for earth canals, $26.90. With higher unit labor costs, this method would soon become more expensive than spraying or burning.

Los Angeles, Calif. C. L. Huff, M. Am. Soc. C.E.

Operating a Sanitary Fill at Fresno, Calif.

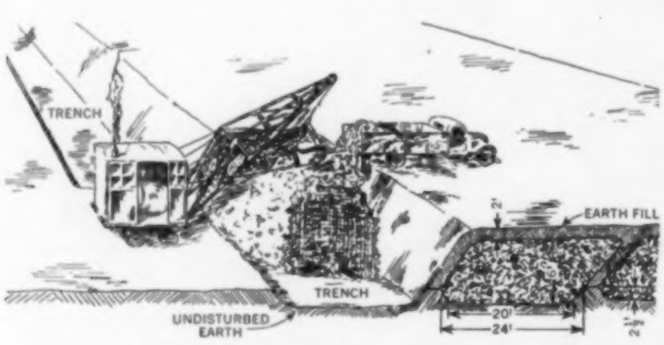
TO THE EDITOR: I was interested in Mr. Casey's description, in the October issue, of the method of disposal by sanitary fill at San Francisco, as this method was closely observed by the city of Fresno in solving its own problem of disposal of mixed refuse by sanitary fill.

The accompanying illustration shows the method of operation of the sanitary fill at Fresno. It should be noted that the land both before and after the fill is practically level. Our work of disposal does not require waste land or a ravine, and at the present time we are using farming land of medium value located within two miles of the city limits. Further, from studies made, we know that after several years this land can again be used for farming purposes.

Shortly before the city of Fresno began the project, an option was obtained for 120 acres of land adjacent to the present site and relatively close to the city limits. However, a petition was filed with the City Council protesting the use of the site. Therefore, we started the project on a piece of land belonging to the Fresno city sewer farm, where the supposed nuisance could not be protested, although the site involved an average haul of nine miles from the center of the city.

It will be noted that the refuse is not unloaded by dumping. A chain attached to a false tail-gate, which has been placed at the front end of the truck, is hooked to the bucket of the shovel and the refuse is pulled directly into the trench. The refuse is compacted to some degree by dropping the bucket onto the pile of uncovered rubbish, after which the refuse is immediately covered. Cover material is obtained by digging the trenches indicated on the left-hand side. The trenches are from 3 to 4 ft deep, just sufficient to obtain enough dirt to make the proper coverage.

The particular advantage of disposal by this system is a complete and proper coverage of refuse. As shown in the illustration, the refuse is dumped in a trench about 24 ft in width, and the shovel operator covers the fill with about 36 in. of loose dirt and compacts it again somewhat by dropping his shovel on the fill. Once every



SKETCH OF THE FRESNO DISPOSAL PLANT

two to four weeks, one of the street graders from the street department smooths the rough covering, so that when another trench is started the trucks drive over the existing fill to the edge of the last trench.

Because of the depth of coverage and the care and promptness with which this coverage is made, there are positively no rats at the sanitary fill. At our request regular and frequent calls are made by inspectors of the State Board of Health. Because of the prompt covering of the refuse and probably, also, because of the large amount of paper, tin cans, and other miscellaneous refuse, there is practically no odor at this fill.

After three years of successful operation of this system, it was not difficult to purchase land adjacent to the site first mentioned, where we have been operating for two years without any protests from the neighbors.

The yearly average of the refuse for this city of 60,000 is 24,306 tons, and the cost of disposal for the past year was 24 cents per ton. This cost includes the operation, maintenance, repair, and depreciation on the shovel, the labor involved, and a complete write-off of the cost of the land. At the present time we are cultivating the cover of the fill made four and five years ago and will sow barley on it. It is probable that after two more years we will sow alfalfa, in which case the land will be more valuable than when it was first purchased.

JEAN L. VINCENZ
Commissioner of Public Works

Fresno, Calif.

Diversion Vexes Highway Finances

TO THE EDITOR: The article, "Is Diversion a Menace or a Myth?" in the September issue, by Hawley S. Simpson calls for the earnest attention of engineers on the highway firing line. His selection of finance data drawn from the experience of recent years proves to him that, diversion or no diversion, sufficient funds are provided and will continue to be provided to carry on adequate programs of highway development.

It is a well-known fact that during the period 1929–1937, customary sources of general taxation dried up to an alarming extent. In many states the contributions from general funds to streets and highways largely ceased, and the resulting gaps were filled partially by distributing larger proportions of state-collected motor vehicle revenues to county and local units and partially by the use of large federal emergency relief grants for street and highway construction and maintenance. The abnormal and impermanent character of these latter grants gives doubtful value to any long-range conclusions. It is also at least doubtful whether it can be safely concluded, as the author seems to imply, that the funds provided during this period were adequate for highway needs.

From his statement that "it matters little whether taxes (motor?) are earmarked for special purposes (highways?) or wholly diverted to the general fund" it appears that no recognition is given to the different motor transport services rendered by the several components of the total highway and street system. This is tantamount to saying that the motor transport service of the vast mileage of purely local roads is identical to that rendered by the main primary and secondary roads forming the backbone of our motor transport system.

Clearly, the task before highway administrators today is to reestablish adequacy and stability in their dependable sources of revenue. Without that, the pressing and manifold engineering and construction problems involved in fitting our roadways for an increasingly heavy, complex, and important traffic cannot be successfully attacked. Clearly, too, revenues from motor vehicle taxes not only are insufficient to even approach the needs of roadway construction and maintenance, but are drawn from only one class of the beneficiaries of street and highway service, whose benefits are distributed almost universally to the motor-vehicle-owning and property-owning public.

The old local tax and public finance systems by which the property-owning public discharged its responsibilities of roadway support have suffered a serious collapse. Only one part of the old system continues to function normally and that is the collection from motor-vehicle owners as users of highway service. I confidently believe that application of the funds to the whole highway system without regard to the varying usage would result in a decidedly lower standard of that service.

During the depression the movement of traffic on our main roadways merely leveled off and, at the first hint of recovery, rose to new volume peaks. This movement represents a segment of the beneficiaries of roadway service, which not only requires greater adequacy in the trunk-line highways it uses, but contributes a large portion of the revenues to pay for them. The requirements to provide other types of highway benefit are not so critical.

Prevention of diversion is by no means the whole answer to the problem of financing our roadways; there is the even greater necessity to properly allocate the source and the expenditure of all highway revenues. But it seems to me to be a matter, not of indifference, but of primary importance that the integrity of our motor-vehicle taxing system be kept intact. It is almost the sole remaining vestige of order and stability in the highway finance picture, and it should be preserved as the corner-stone of the equitable and stable finance structure which must eventually be built.

MURRAY D. VAN WAGONER, M. Am. Soc. C.E.
President, American Road Builders Association

Lansing, Mich.

SOCIETY AFFAIRS

Official and Semi-Official

Plans Crystallize for Annual Meeting

New and Old Features Combined to Form Attractive Program

IT WAS EXPECTED that the cancellation of the British American Engineering Congress scheduled to be held in September would focus new interest on the succeeding Annual Meeting, also to be held at Headquarters. This, in fact, is what has happened, but at the same time the change of plans has created problems of accommodation. These have been fully studied by the Annual Meeting Committee, and a satisfactory solution has been developed.

In particular the requests for time to hold meetings of the Technical Divisions, while gratifying in themselves, proved somewhat embarrassing. Divisions which had lost the opportunity of gathering at the Fall Meeting when that was abandoned naturally wished to hold sessions in January. There were others that had been willing to forego the Fall Meeting with the idea of holding sessions at the Annual Meeting instead. Accommodating the Divisions in each of these categories gave a more than full schedule for the technical program. To meet these augmented needs, the committee has hit upon the idea of extending the Technical Division sessions from Wednesday afternoon to Friday noon, thus providing for 12 sessions. The necessary adjustments in the usual arrangements have been satisfactorily made.

BUSINESS MEETING AS USUAL

No innovations are scheduled for the Wednesday morning gathering, January 17, which opens the Annual Meeting. This will be held in the auditorium of the Engineering Societies Building, with a program including reports of the Board of Direction, the Secretary, and the Treasurer, followed by a business meeting.

Colorful ceremonies will be observed in connection with the conferring of honorary membership on three American engineers, Herbert S. Crocker, Henry S. Jacoby, and T. U. Taylor; and on one Canadian engineer, J. M. R. Fairbairn. A fifth honorary member was recently elected in the person of W. J. E. Binnie, president of the Institution of Civil Engineers of Great Britain. It is regretted that Mr. Binnie cannot receive his honorary membership at the same time and thus participate in the official recognition given to those receiving this high honor.

Another item on the program is the award of Society and other prizes as follows: Norman Medal to Charles H. Lee, J. James R. Croes Medal to C. A. Mockmore, James Laurie Prize to Stanley M. Dore, Arthur M. Wellington Prize to Rufus W. Putnam, the Collingwood Prize for Juniors to B. K. Hough, Jr., and the Rudolph Hering Medal of the Sanitary Engineering Division to Albert J. Schafmayer and the late B. E. Grant. All are Members of the Society except B. K. Hough, Jr., who is a Junior, and B. E. Grant who was not on the membership roles.

LUNCHEON PROVIDED

After the formalities of acknowledging the President-elect, together with the new Vice-Presidents and Directors, the gathering will recess to an upper floor where luncheon will be served following the usual custom. This function is always largely attended and affords a convenient meeting place for a great many members, even some who cannot attend the meeting that precedes it. It obviates the necessity of donning hats and coats and seeking an outside restaurant. Thus additional time is available for social contact among congenial surroundings. Immediately following the luncheon, the afternoon technical sessions will begin in various rooms in the Headquarters building.

VARIED TECHNICAL PROGRAM

For the advance information of members who are especially interested in the presentation of technical material, the following summary is given of the schedule for the succeeding two days: Wednesday afternoon, January 17, general meeting in auditorium followed by Student Conference, meetings of Sanitary Engineering and Soil Mechanics and Foundations Divisions; Thursday forenoon, January 18, meetings of Sanitary Engineering, Soil Mechanics and Foundations, and Waterways Divisions; Thursday afternoon, January 18, meetings of Waterways, Power, Structural, and Highway Divisions; Friday forenoon, January 19, meetings of Power, Structural, and City Planning Divisions.

It will be noted that one extra forenoon is given over to the Divisions. In addition, time on Wednesday afternoon is allocated for the same purpose. It is believed that by these means ample opportunity will be afforded for completing this ambitious program of technical papers and discussions.

INSPECTION TRIPS INCLUDED

Such changes in the normal schedule have had the unavoidable effect of interfering with the full-day excursion that has normally been a feature of the Annual Meeting. Instead, additional time has been allocated to inspection trips, in recognition of their growing popularity. All of Friday afternoon as well as Saturday forenoon has been set aside for such tours.

Arrangements have been made for both men and women to go on these trips. Among the possible projects to be visited, according to the schedule arranged by the committee, are included those illustrating parkway development, tunnel construction, sanitary works, bridges, and housing. It is believed that the arrangements made are varied enough in appeal to satisfy the special interests of all.

ENTERTAINMENT FEATURES

With its customary assiduity, the Ladies Committee is making arrangments to entertain the women with a varied program of teas, visits, and other social events. The largest formal function, always popular with both men and women, will be the dinner and dance. This will follow usual custom by being held on Wednesday evening. For it the ballroom of the Waldorf Astoria, one of the finest settings in the city for such an event, has been reserved.

An innovation is being introduced in arrangements for the Smoker, always held on Thursday evening. This year it will be something more than a Smoker in the usual sense—it will combine a beefsteak supper and an entertainment, thus replacing the simpler type of gathering held in previous years. Instead of leaving it to members to arrange their own plans for dinner separately or in groups, the committee has decided upon a full evening's program that will bring everybody together—with a single charge that will include supper, smokes, and entertainment. This arrangement is believed to offer a distinct advance from the standpoint of sociability and general enjoyment.

EARLY REGISTRATION URGED

As the last Annual Meeting set a record for registration, with about 2,380 names on the list, members are reminded of the importance of registering early. In view of the likelihood that the forthcoming meeting will attract even a larger number, members are urged to use the registration blank that will soon be mailed to them. In this way they may order tickets for trips and social events in advance, thus relieving congestion at the registration desk and saving their own time. By so doing they will also assist the Local Committee in its task of arranging for the anticipated attendance and of making ample reservations for all events.

These various plans for the 1940 Annual Meeting are now assuming final form, and the program itself, with complete details, will be published in the January issue of CIVIL ENGINEERING. In accordance with past practice, however, a summary program will be mailed during December to members of the Society, outlining the various events and enclosing the necessary registration and order blanks.

Those who have come to look forward to the post-meeting tour for members, their families, and guests will be interested in the announcement of arrangements for this event given in a separate item.

While in some of its details the coming Annual Meeting may appear "different," its general structure will be recognized as familiar, including the good features of other years. An outstanding gathering of civil engineers is assured. This brief advance notice is presented merely to give a preliminary view of the features in store for those who attend.

Winter Tour to Follow Annual Meeting

Hampton Roads District Offers History and Romance as Well as Entertainment

FOR SOME YEARS a brief tour, usually to Bermuda and return to New York, has proved a popular feature incident to but following the Annual Meeting of the Society. General conditions of travel being affected by international events, a change in the itinerary was indicated as desirable, while still maintaining the delightful social features of all other previous tours. A happy solution has been found in fixing upon the historic and vacation areas of southern Virgina as the objective of the 1940 winter tour.

SEA AND LAND ITINERARY

In condensed form the adopted schedule appears below:

Saturday Jan. 20	Sail from New York at noon under the American flag on S.S. *Robert E. Lee.*
21	Reach Norfolk in the early morning. At 8:30 take motor coach for an all-day tour into historic Virginia; the James River, Portsmouth, Williamsburg (visit the College of William and Mary, the Governor's Mansion, the Capitol, and Raleigh Tavern), Jamestown (historic ruins), Yorktown and its battlefield, Langley Field, Old Point Comfort, and via ferry to Virginia Beach. Over night at Hotel Cavalier, room with bath, both land and ocean view.
22	All day at Virginia Beach. The day will be free for individual pleasures, such as swimming, riding, and golf. In the late afternoon transfer to the pier by motor coach, and sail from Norfolk by the S.S. *George Washington* at 7:30 in the evening.
23	Another day at sea with the coast in view much of the time. Arrive in New York at 3 p.m.

There are few parts of America with more to offer in the way of patriotic and historic interest than the Hampton Roads district. At Jamestown, in 1607, the first permanent English settlement in America was founded. Its remains are preserved as a national shrine. Williamsburg, Colonial capital of Virginia, has recently been restored in one of the most remarkable undertakings of its kind ever accomplished. Among the 68 buildings restored and the 139 buildings that have been rebuilt, one treads again the Colonial streets and finds the atmosphere of three hundred years ago. The spirit of the great departed leaders of Virginia and of America pervades Williamsburg. Yorktown also has its patriotic atmosphere but in a military sense. The town itself is beautiful, and nearby are the ancient ramparts and the battlefields, scene of one of the most climactic events in American history. Interspersed with these features of century-old interest will be others strictly up to date, such as Langley Flying Field, all combining to make an exceptional day of sightseeing on Sunday.

IN THE FORMAL GARDEN OF THE RESTORED GOVERNOR'S PALACE, WILLIAMSBURG, VA.

On Monday a quieter program is in contemplation. The Hotel Cavalier at Virginia Beach is one of the really fine resorts along the Atlantic Seaboard. Located on a high bluff close to the shore, it offers its own 300-acre estate of gardens, forests, and lawns, not forgetting a fine swimming pool within the hotel itself.

Financial arrangements for the tour are based on the principle of the all-expense plan. The cost includes first-class accommodations and meals, admission tickets, and all other expenses except tips. The total is expected to be considerably less than the living expenditures of the usual visitor staying in New York City. From this standpoint, the tour should be very attractive as a continuation of the Annual Meeting. Full details will shortly be available and may be had by addressing the Secretary at Headquarters, or the Society's Travel Consultant, Leon V. Arnold, 36 Washington Square West, New York, N.Y.

Professional Records of Nominees

Brief Biographical Sketches of Candidates for Society Offices

JOHN P. HOGAN

JOHN P. HOGAN was born in Chicago, Ill., on June 12, 1881, and educated at the University School in Chicago and at Harvard University. He was graduated from the latter in 1903 with the A.B. degree, and received the S.B. degree in 1904. From 1904 to 1917 he was engaged in the design and construction of municipal improvements—the greater part of the time in the service of the city of New York on the construction of the Catskill Aqueduct where he was, successively, assistant engineer, division engineer, and acting deputy chief engineer.

At the outbreak of the World War he was called into service as Captain of Engineers and assigned to the 11th Engineers, with whom he left for France early in 1917. He served two years in France in grades ranging from captain to lieutenant-colonel on the general staff. He received the Distinguished Service Medal, the Legion of Honor, the Conspicuous Service Cross (New York State), and the order of the Purple Heart.

After the war Colonel Hogan became director of the New York Water Power Investigation under the late William Barclay Parsons, Hon. M. Am. Soc. C.E. This work was done for a committee of all the utilities in New York State and involved surveys and cost estimates on all the undeveloped water power in the state and a survey of all the existing power facilities in the state. At the conclusion of this survey—in 1923—he entered the New York consulting firm of Parsons, Klapp, Brinckerhoff, and Douglas, of which he became a member in 1926. He has participated with the firm in a number of

JOHN P. HOGAN
Nominee for President of the Society

large engineering and construction projects, his personal work consisting largely of the development and utilization of electric power. He has served as marketing engineer for the St. Lawrence Power Development Commission of the State of New York and as consulting engineer to the Corps of Engineers, U.S. Army, on the power surveys of the Delaware and Susquehanna rivers. From 1933 to 1937 he was consultant to the Corps of Engineers on the construction of the Bonneville Project, and during this same period served as consulting, designing, and supervising engineer to the Platte Valley (Nebraska) Public Power and Irrigation District.

From June 1936 to July 20, 1939, Colonel Hogan was chief engineer and director of construction of the New York World's Fair 1939, directly responsible for $30,000,000 worth of construction work and supervising about $70,000,000 of additional work. He was also a member of the Management Council of the Corporation and, during the latter part of the period, vice-president and chief engineer of the Corporation. Since July 20 he has served in an advisory capacity as vice-president and chief engineering consultant. In recognition of this work he was made an officer of the Order of the Crown of Romania.

Colonel Hogan joined the Society as a Junior in 1904, becoming an Associate Member in 1912 and a Member in 1915. Long active in Society affairs, he served as Director from 1921 to 1923 and as Vice-President in 1934 and 1935. He has been president of the Metropolitan Section of the Society, vice-president of the Society of American Military Engineers, and chairman of the Construction League of the United States.

GEORGE L. LUCAS

GEORGE L. LUCAS was born in New York City on January 5, 1877, and was graduated from the School of Mines, Columbia University, in 1898, with the degree of civil engineer. For two years he was employed as structural draftsman and steel inspector on buildings and bridges. From 1900 to 1904 he was an inspector, and in that period became principal assistant to the general inspector of materials for the Board of Rapid Transit Railroad Commissioners of the City of New York. He then spent one year as resident engineer in charge of construction of improvements such as buildings, roads, pier, and sewer system at Castle Gould, N.Y.

Returning to railroad work in 1906 with the Board of Rapid Transit Railroad Commissioners for the City of New York, Mr. Lucas served twenty-six years in various capacities under that Board and its successors—the Public Service Commission, Transit Construction Commissioner, Transit Commission, and the present Board of Transportation. For six of these years he was engaged in the design of subway structures—for three years as assistant engineer in charge of design. For nine years he was in charge of the Materials Inspection Division, first as general inspector of materials, and later as division engineer, establishing physical and chemical laboratories, and having in charge the making of specifications for materials, investigations of materials and their properties, inspection and testing of materials for all structures. For two of these years he was also assistant to the chief executive officer of the Transit Commission.

GEORGE L. LUCAS
Nominee for Vice-President, Zone I

In 1923 he became chief executive officer of the Transit Commission, a regulatory and construction body, in charge of the Commission's organization and of the execution of the Commission's orders on railroads and transportation companies in the city of New York, and at times sat as commissioner holding hearings. Upon the separation of the regulatory and construction function of the Transit Commission, he resumed his duties as division engineer in charge of the Materials Inspection Division, holding this position for nine years. Toward the end of this period he acted as purchasing agent for the city-owned Rapid Transit Railroad (Independent System).

During 1918 Mr. Lucas was a dollar-a-year man for the U.S. War Industries Board, and was chairman of the New York Committee on Building Materials, allocating materials for the U.S. Army, the U.S. Navy, and municipalities in the New York district. From 1916 to 1922 he was also consultant on materials for the construction of the Holland Tunnel.

He retired from the city service in 1933, and became engineer of inspection for The Port of New York Authority, in charge of the inspecting and testing of materials and field control of concrete for the construction of the Lincoln Tunnel and the George Washington Bridge improvements. In addition, he performs similar work for the Triborough Bridge Authority and the New York City Tunnel Authority on their various projects. During the period 1911 to 1939 he had charge of the inspection of approximately $226,000,000 of engineering materials.

As president of the Metropolitan Section of the Society, Mr. Lucas organized the Professional Engineers' Committee on Unemployment and induced the other three Founder Societies to join and work with the civil engineers. By January 1935 this Committee had provided upward of 7,800 jobs, and had raised and distributed to needy cases over $210,000 contributed by members of the engineering profession.

Mr. Lucas joined the Society as Associate Member in 1904, becoming a Member in 1917. He served as Director of the Society from 1927 to 1929, and was president of the Metropolitan Section in 1931 and 1932. He is a registered professional engineer, State of New York, and a member of the American Society for Testing Materials, the Municipal Engineers of the City of New York, and the Engineers' Club of New York.

JOSEPH JACOBS

JOSEPH JACOBS was born in Leavenworth, Kans., on November 21, 1869, and was graduated from Kansas State University in 1889 with a degree of B.S. in C.E. His professional experience has included two years with the U.S. Geological Survey on topographic mapping, stream gaging, and the examination and survey of reservoir sites and dam sites; about twelve years in railroad work in California and the Southwest; and about five years in active irrigation work, chiefly for the federal government, as district engineer and consulting engineer for the U.S. Reclamation Service, on various Western irrigation developments and including, also, an assignment to the Puerto Rico Reclamation Service. Since 1910, except for two years with the A.E.F. in France as major of engineers, Mr. Jacobs has been in private practice as a consulting engineer, with headquarters in Seattle, Wash. This latter practice has included the service of municipalities, irrigation districts, federal and state governments, and railroads, in connection with irrigation, power, water supply, and other engineering developments. He has made investigations, in connection with irrigation, power, and bridge projects, on most of the important Western streams, including the Rio Grande, Colorado, San Joaquin, American, Sacramento, Willamette, Deschutes, Lewis, Skagit, Wenatchee, Yakima, Snake, Spokane, and Columbia rivers.

JOSEPH JACOBS
Nominee for Vice-President, Zone IV

He has served as member of numerous commissions or boards concerned with important engineering developments, among them

a commission appointed by the governor to draft a water code for the state of Washington; Cedar River Project and Skagit River Project, for the city of Seattle; investigations relating to irrigation and flood control of the Colorado River delta, for the federal government and the state of California; investigations relating to present and potential use, and to possible surplus waters, of the Colorado River, for the federal government; investigations of Columbia River irrigation and power possibilities, for the federal government and the state of Washington; investigation of several navigation canal projects for the state of Washington; investigation of certain phases of the Passamaquoddy Tidal Power Project, for the federal government.

Mr. Jacobs has served as consultant on numerous irrigation and dam projects in the Western states, in British Columbia, and in Puerto Rico; for the Lake Union Bridge Project, Seattle; for the Grade Separation Commission, Seattle; for the PWA in connection with the Nebraska Public Power Projects; for the National Resources Committee in connection with several Pacific Northwest investigational projects; for the U.S. Bureau of Reclamation, as member of engineer boards for several of its projects, including, among others, the Imperial Dam and All-American Canal Project in California, the Colorado–Big Thompson Project in Colorado, Bartlett Dam in Arizona, Marshall-Ford Dam in Texas, Alcova and Seminoe dams in Wyoming, Deer Creek Dam in Utah, and Caballo Dam in New Mexico. He is a member of the American National Committee of the International Commission on Large Dams.

He has always interested himself in civic affairs and has served as an officer for numerous business, welfare, and technical organizations. Among these he has served as president of the Washington Irrigation Institute and the Washington Natural Resources Association; as vice-president of the Seattle Chamber of Commerce; and as director of the Washington Chamber of Commerce.

Mr. Jacobs became an Associate Member of the Society in 1901, and a Member in 1909. In 1926 and 1927 he served as chairman of the Irrigation Division of the Society, and he was Director from 1929 to 1931. He has also been president of the Seattle Section. His other technical society affiliations include membership in the American Water Works Association, the American Geophysical Union, and the Society of American Military Engineers.

Ernest P. Goodrich

Ernest P. Goodrich was born and reared in southern Michigan. He graduated from Michigan State Normal College in 1894 and, after two years of teaching, entered the University of Michigan, from which he received the degree of bachelor of science in civil engineering in 1898. That same year he received the degree of bachelor of pedagogy from Michigan State Normal College. After a few months of summer work with the Detroit Edison Company, he went to Washington to become the civilian engineer assistant to the army officer in charge of public buildings and grounds under the War Department. It was during this period that he started his experiments on piles and pile driving. In 1899 he was given a commission as civil engineer in the U.S. Navy with the rank of lieutenant, jg, and was ordered to the New York Navy Yard.

Ernest P. Goodrich
Nominee for Director, District 1

While he was at the New York Navy Yard, the practical reconstruction of the Yard after the Spanish War was carried out. During this period, also, he carried through to completion his experiments on piles and pile driving and submitted his first paper on that subject to the Society. His research activities then turned to earth pressures and related phenomena. In 1903 he resigned from the Navy to become chief engineer of the Bush Terminal Company and Affiliated Corporations. In this capacity he had charge of the design and construction of the Bush Terminal, situated in South Brooklyn on New York Bay. There he developed original designs for filled-pier construction and other innovations. Upon the termination of his contract with the Bush Terminal he entered contracting work with several successive organizations, in each of which he was a partner. In 1910 he left the contracting field to be appointed consulting engineer to the New York City Department of Public Works, Borough of Manhattan, which position he occupied for six years. During this period he served as a consultant on various municipal boards and commissions and, also, as chairman of what came to be known as the Board of Consulting Engineers of the several boroughs.

In 1916 Mr. Goodrich resigned from the Department of Public Works to become executive director of the New York Bureau of Municipal Research, which also did work widely through the United States and Canada. At the outbreak of the World War he resigned to work for the government at a dollar a year. His services included work in a civilian capacity with various departments, including a Commission on the Port of New York Operations and the Quartermaster General's Department.

After the armistice Mr. Goodrich returned actively to his consulting practice which had been gradually developing since 1900. He had acted as consultant in the design of various harbors in this country, the Philippines, and South America. He had also been active in city planning work and had served as consultant to the Regional Plan of New York and its environs. His work in connection with street traffic led to the development of a special system of two-wire progressive traffic control, for which a patent was eventually issued. Mr. Goodrich is also generally considered the original inventor of the progressive street traffic control system.

In 1929 he was requested by the Chinese government to come to China and prepare a comprehensive city plan for the reconstruction of the new national capital at Nanking. About ten years later he was called back to China to design a comprehensive plan for the development of a harbor and port city below Canton.

He has always been interested in educational work and has lectured at nearly a score of universities from time to time and given courses in cantilever and suspension bridges at Columbia University and in engineering economics and city planning at New York University. In 1935 he was awarded the honorary degree of doctor of engineering by the University of Michigan, and the following year the Michigan State Normal College gave him the honorary degree of master of education.

Mr. Goodrich joined the Society as a Junior in 1900 and became a Member in 1905. In the latter year he was the recipient of the Collingwood Prize for Juniors. He has always been active in the affairs of the Society and the Metropolitan Section, has served on numerous Society committees, and was for over ten years chairman of the Committee on Engineers' Salaries. At present he is the Society's contact member for the Columbia University Student Chapter. He was the first president of the Institute of Traffic Engineers and a charter member of the Institute of Consulting Engineers, and has numerous other technical and civic affiliations.

Lazarus White

Lazarus White was born in Rochester, N.Y., on February 26, 1874. He received his early education in the public and high schools of Rochester and graduated from Columbia University in 1897 with the degree of civil engineer. After graduation he was employed as inspector with the U.S. Engineer Corps at Key West, Fla., and later with the Pennsylvania Railroad on construction of terminals, docks, and similar structures at Jersey City, N.J.

From 1900 to 1906 he was employed by New York City as assistant engineer and section engineer on the construction of the first New York subway. Later, he was division engineer on the construction of the Catskill Aqueduct in Ulster County and Manhattan, remaining in that capacity until 1914. From 1914 to 1919 he was with Smith Hauser and MacIsaac as junior partner and manager of construction of the William Street (New York) subway, Camp Meade, and various other works.

Since 1919 Mr. White has been president of Spencer, White and Prentis, Inc., New York engineers and contractors, in whose work Mr. White has been very active. In part this work involved the construction of a section of the Sixth Avenue subway and participation in the construction of two sections of the Eighth Avenue subway, contracts for underpinning of structures along certain subway sections, and consultation and management in connection with other subway sections. Mr. White is president of Pleasantville Constructors, Inc., contractors for a section of the Delaware Aqueduct.

Lazarus White
Nominee for Director, District 1

He was active in the construction of locks and dams on the Mississippi River, and in the construction of foundations for numerous important structures, such as the Bank of Manhattan Building, the Criminal Courts Building, Starrett Lehigh, and the Abraham and Straus Department Store. He has contributed to improving methods of underpinning buildings by the Pretest System. Mr. White has also served as consulting engineer for the U.S. government in connection with proposed changes of surface conditions at the Washington Monument, for the city of Detroit in connection with tunnel construction, and for the New York World's Fair in connection with foundations. At present he is a lecturer on foundations at Harvard University.

Mr. White is the author of the *Catskill Water Supply of New York City* and co-author of *Underpinning* and of numerous reports and papers. He is chairman of the Committee on Foundations of the Soil Mechanics and Foundations Division of the Society, and is a member of other Society committees. He is also a member of the American Society for the Advancement of Science, the New England Water Works Association, the Harvard Engineering Society, and the Municipal Engineers of the City of New York.

Clarence M. Blair

Clarence M. Blair was born at New Haven, Conn., on August 21, 1885. He received his education in the public school system of New Haven, and graduated from the Sheffield Scientific School of Yale University in 1904.

From the time of his graduation until 1930 he was with the late Albert B. Hill, M. Am. Soc. C.E., consulting engineer of New Haven, engaged in a general engineering and surveying practice, and specializing in water supply. Mr. Blair acted as engineer in charge on a number of large developments for the New Haven Water Company, including the Wepawaug Tunnel and Dam; the Watrous Dam; the North Branford Development, consisting of dams, tunnels, and pipe lines; and also the Laurel Dam for the Stamford Water Company.

In 1930, after Mr. Hill's death, Mr. Blair continued the general practice of civil engineering with the firm of Blair and Marchant, Inc., of which he was president and treasurer. This firm specialized in water-works problems, and served as engineers for a number of private water companies and municipalities in Connecticut in the development of water supplies, design and supervision of construction, valuations, rate cases, and other work. The firm has also continued a surveying practice.

Clarence M. Blair
Nominee for Director, District 2

On the death of Mr. Marchant in 1938, the name of the firm was changed to Clarence M. Blair, Inc., Consulting Engineers, and Mr. Blair has continued as president and treasurer. He is now consulting engineer for the large Saugatuck River development of the Bridgeport Hydraulic Company, and is also continuing as engineer for a number of other water companies and water departments.

Mr. Blair was a member of the Connecticut Board of Civil Engineers having supervision of dams from 1930 to 1939, and was recently appointed by Governor Baldwin to a four-year term as a member of the State Board for Supervision of Dams and Reservoirs. He is a registered professional engineer and land surveyor in Connecticut, holding Certificate No. 6.

Mr. Blair became an Associate Member of the Society in 1911, and was elected a Member in 1917. He was a charter member of the Connecticut Section of the Society, serving as its secretary and treasurer from 1921 to 1931. He is also a member of the Connecticut Society of Civil Engineers, and served as its secretary and treasurer from 1923 to 1931, and as its president in 1934. He is a member of the American Water Works Association, the New England Water Works Association, and Sigma Xi.

Clifford G. Dunnells

Clifford G. Dunnells was born in Pittsburgh, Pa., in July 1875. He received his early education in the public schools of that city and his technical training at Lehigh University, graduating in 1897 with the degree of civil engineer. The first three years of his professional experience were spent as draftsman and estimator with the Pittsburgh Bridge Company, structural steel fabricators. When the American Bridge Company was formed in 1900 he joined that organization, spending ten years as draftsman, contracting engineer, and designing engineer.

In 1910 Mr. Dunnells joined the faculty of the Carnegie Institute of Technology and is now professor of civil engineering. He organized a department of building construction, which was planned for the student who wished to enter the construction industry. This program was the first in its field to have a definite four-year curriculum.

Clifford G. Dunnells
Nominee for Director, District 6

In addition to his teaching work, Mr. Dunnells has practiced structural engineering for a number of years, having formed a partnership in 1926 with E. N. Hunting, M. Am. Soc. C.E. Some of the most important commercial and industrial buildings in the Pittsburgh area have been designed and built under the direction of this firm, and many foundation and bridge projects have been executed under their supervision.

From 1923 to 1926 Mr. Dunnells served as a member of the Building Code Committee of the City of Pittsburgh and more recently has been chairman of committees preparing the welding ordinance and the reinforced concrete ordinance.

He joined the Society as a Junior in 1902, becoming an Associate Member in 1907 and a Member in 1913. He has always taken an active part in the affairs of the Pittsburgh Section, which he served as president from 1935 to 1937. In October 1939 he was elected by the Board of Direction to fill a vacancy in its membership.

Mr. Dunnells is a member of the Engineers Society of Western Pennsylvania and of the American Concrete Institute. He is a registered engineer in the states of Pennsylvania and Ohio.

Armour C. Polk

Armour C. Polk was born in Little Rock, Ark., on September 12, 1879. He received his early education in the private schools of San Antonio, Tex., and the public schools of Galveston, Tex. In 1889 he graduated in engineering from the Virginia Military Institute and, after two years of railroad location work in the Southwest, entered Rensselaer Polytechnic Institute in 1901, graduating there with the degree of civil engineer in 1903. The Virginia Military Institute conferred the postgraduate degree of civil engineer upon him in June 1939.

After graduating from Rensselaer, Colonel Polk was engaged on the construction of the Pennsylvania tunnels under the East River in New York, and from 1905 to 1909 was employed by Sanderson and Porter, engineers of New York, on the construction of various public utility plants and lighting systems in New Orleans, La., and Mobile, Ala. From 1909 to 1912 he was division engineer for the Santa Fe Railroad in Oklahoma and Texas, in charge of grade revision, relocation of lines, and other railroad engineering work in

this territory. In 1912, he was engaged on the rebuilding of a power station for Sanderson and Porter in Springfield, Mo. From 1912 to 1914, he was resident engineer for the Alabama Power Company in charge of the first large hydroelectric development on the Coosa River. He returned to Sanderson and Porter and, from 1914 to 1923, served in various capacities as superintendent, construction engineer, division construction manager, and construction manager on all classes of public utility work. From 1923 to 1931 he was vice-president and president of the Dixie Construction Company, for which he constructed a number of large hydroelectric developments, transmission lines, water, street railway, and gas projects in the Southeastern and some of the Northern states.

Since 1931 Colonel Polk has been in general and consulting engineering practice, handling among other developments the design and construction of the Industrial Water Supply System for the city of Birmingham, Ala., and the studies for and design of a sintering plant and electric furnace for producing phosphoric acid. He volunteered for the Spanish-American War in 1898 while a cadet at Virginia Military Institute, but was rejected on account of his youth. He volunteered for the World War and was accepted, but was later rejected due to a serious operation a year previously. He is a colonel, Corps of Reserve Engineers, assigned to special duty with the Chief of Engineers.

ARMOUR C. POLK

Nominee for Director, District 10

Colonel Polk became a Junior in the Society in 1903, an Associate Member in 1906, and a Member in 1913. He was awarded the Thomas Fitch Rowland Prize in 1916. He has served as a director of the Alabama Section and has been very active in its affairs, particularly Student Chapter work.

He is a registered engineer in New York and in Alabama. Upon passage of the engineers' licensing law in Alabama in September 1935, he was appointed a member of the new licensing board in 1936 and elected chairman. Upon expiration of his first term he was reappointed and is now serving as chairman of that board. He served as vice-president and, later, as president of the National Council of State Boards of Engineering Examiners. He is a member of the American Concrete Institute and the Engineers Club of Birmingham. Colonel Polk was drafted by the Jefferson County (Alabama) Public Welfare Board to organize and administer the first relief program (CWA).

CHARLES G. HYDE

CHARLES G. HYDE was born in Yantic, Conn., on May 7, 1874 He graduated from the course in sanitary engineering at the Massachusetts Institute of Technology in 1896, receiving a B.S. degree. The first four years of his professional experience were spent in the engineering department of the Massachusetts State Board of Health and were, for the most part, concerned with problems of water supply, sewerage and sewage disposal, and typhoid fever epidemiology. The next two years, 1900 to 1902, were spent at the Spring Garden and Torresdale Testing Stations at Philadelphia as assistant engineer and assistant engineer in charge of the water purification experiments conducted there. From 1902 to 1905, he served under James H. Fuertes, M. Am. Soc. C.E., as resident engineer in charge of water filtration experiments and the design and construction of pumping and filtration works for the city of Harrisburg, Pa. Since July 1905 he has been an instructor in the University of California with the successive titles of assistant professor, associate professor, and professor of sanitary engineering, the last since 1909.

During and following the World War, Professor Hyde served as an active and reserve officer in the Sanitary Corps of the U.S. Army, with the ranks of captain and, since October 1918, of major. He served as camp sanitary engineer at Camp Meade, Md., and, later, in the office of the surgeon general at Washington, acting as officer in charge of the sanitary engineering division of the Sanitary Corps from February 15 to June 12, 1919. Prior to entering the service in 1918 he served as a member of a board of three engineers charged with the design and installation of water and sewerage works for Camp Freemont, Calif.

CHARLES G. HYDE

Nominee for Director, District 13

During the period since 1906 Professor Hyde has served as consulting engineer on many problems and projects, mainly in California, related to water power, water supply (including purification), sewerage and sewage disposal, refuse collection and disposal, and general environmental control, including stream and ocean shore pollution and its ameliorations.

Professor Hyde became an Associate Member of the Society in 1902, Member in 1909, and Life Member in 1937. He served as secretary of the executive committee of the Sanitary Engineering Division from 1931 to 1934, and as chairman in 1934 and 1935. He was a member of the Water Supply Committee of the Division from 1931 to 1933, and since 1936 he has been chairman of the Division's Committee on Advancement of Sanitary Engineering. He served as a vice-president of the San Francisco Section of the Society in 1933 and 1934, and as president in 1935.

He has contributed many articles to the technical press

Engineering Foundation Officers

GEORGE ERLE BEGGS, M. Am. Soc. C.E., chairman of the department of civil engineering at Princeton University, has been elected chairman of the Engineering Foundation, research organization of the Founder Societies, for the year ending in October 1940. O. E. Buckley, executive vice-president of the Bell Telephone Laboratories, New York, succeeds Professor Beggs as vice-president. Otis E. Hovey, Hon. M. Am. Soc. C.E., was reelected director, and John H. R. Arms was again named secretary.

The executive committee is headed by Professor Beggs as chairman. Other members are F. F. Colcord, vice-president of the U.S. Smelting, Refining and Mining Company, New York; Kenneth H. Condit, executive assistant to the president, National Industrial Conference Board; A. L. J. Queneau, metallurgist of the U.S. Steel Corporation, New York; and Mr. Buckley.

The following were elected to the research procedure committee: H. E. Wessman, M. Am. Soc. C.E., professor of civil engineering at New York University; Sam Tour of Lucius Pitkin, Inc., New York; W. H. Fulweiler, M. Am. Soc. C.E., consulting engineer of Philadelphia; L. W. Chubb, director of research laboratories of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.; Mr. Buckley; and Mr. Condit.

Professor Beggs was appointed to represent the Engineering Foundation on the executive board of the National Research Council. Dr. Hovey will be the Foundation's representative on the Council's Highway Research Board.

Dean A. A. Potter, of the Purdue University School of Engineering, and H. R. Woodrow, vice-president of the Consolidated Edison Company of New York, were appointed to the Foundation Board. Dean Potter represents the A.S.M.E., and Mr. Woodrow the A.I.E.E.

GEORGE ERLE BEGGS

[*As this issue goes to press news comes of the death of Professor Beggs at Princeton, N. J., on November 23—Editor.*]

United Engineering Trustees, Inc., Summarizes Activities of Its Thirty-Fifth Year

Library and Engineering Foundation Present Encouraging Reports

Progress in a wide variety of research projects and continued growth of the Engineering Societies Library were encouraging notes in the annual report of United Engineering Trustees, Inc., for the fiscal year ending October 26, 1939. The financial position of the corporation, it appears, has also been strengthened during the year, its investment advisers reporting an improvement in the quality of its portfolio and stating that its position "is considerably more liquid than a year ago."

Items from the Library's Report

During the year the Engineering Societies Library was used by 43,110 persons, 1,160 more than in the preceding year. Of these, almost a fourth were served by mail or phone. Services included the making of translations, compilation of bibliographies, lending of books, and photoprinting.

Through purchase and gift, the collection increased during 1939 from 144,262 volumes, 7,408 maps, and 4,391 searches, to 146,999 volumes, 7,564 maps, and 4,440 searches. Cataloging is up to date, and the work of repairing and rebinding 1,268 valuable and rare books has been completed.

Research of Interest to Civil Engineers

Among the research projects sponsored or contributed to by Engineering Foundation are 12 of particular interest to civil engineers. Four of these are activities of the Soil Mechanics and Foundations Division of the Society, and seven come under the jurisdiction of the Special Committee on Hydraulic Research. The remaining project was in the structural field. The year's activities in each of these researches may be summarized as follows:

Earths, Dams, and Embankments (L. F. Harza). The Committee has accumulated and studied data on methods used for recording static water pressure in embankments and foundations. Plans of the three most promising methods of obtaining these settlements and pressures were prepared and sent to the Committee members in March 1939, for comment and criticism with a view toward preparing a report upon the method, or methods, which appear to be the best. The Committee plans to present one or more papers at the next Technical Session of the Division, which will probably be held in Denver in 1940.

Sampling and Testing (Joel D. Justin). Principal work of this Committee continues to be the development of better methods and equipment for obtaining undisturbed samples. Dr. M. Juul Hvorslev, the research engineer for the Committee, makes his headquarters at Cambridge, Mass., where he has available the facilities of the Soil Mechanics Laboratory of Harvard University and the advice of Dr. Arthur Casagrande. A report on the present status of the art of obtaining undisturbed samples was presented to the American Society of Civil Engineers at the Chattanooga meeting in April 1939. Copies of this report have been sent to leading engineers for comment and it will be prepared in final form at an early date.

Seepage and Erosion (Prof. Glennon Gilboy). The Committee has sponsored the continuance of model studies on earth dams at the University of Minnesota under Prof. Lorenz G. Straub, and has taken under consideration the problem of rational design of drainage filters for dams, dikes, and levees. Information on filters from tests under way at Harvard University and the Massachusetts Institute of Technology for the U.S. Army Engineers, is being collected and will be submitted at an early date as an interim report summarizing and correlating the results from these various sources. Main objectives of the Committee study, at present, are: (1) development of relatively simple grading requirements for filter materials, and (2) development of relatively simple tests to determine the suitability of local materials for filters.

Foundations (Lazarus White). The Committee has collected data and is compiling results of observations on lateral earth pressures and pressures on concrete forms. A paper on "Lateral Earth and Concrete Pressures," by Messrs. Paaswell and White, was published in the September 1938 Proceedings. The final discussion of this paper is now in the hands of the Society and includes large-scale observations of earth pressures measured hydraulically in an earth cut for the Sixth Avenue Subway in New York City. Observations on the behavior of typical "quick" sands and their mechanical and hydraulic properties are being made by Mr. Fruhauf under the direction of the Committee. The Committee expects to continue this work in cooperation with Columbia University. A paper on "Settlement Studies of Structures in Egypt," by Prof. Gregory P. Tschebotareff, was presented during the Technical Session of the Division at Rochester in October 1938, and was published in Proceedings, October 1938. The Committee cooperated in the preparation of this paper and in the expense of the illustrations. Professor Tschebotareff, with the cooperation of the Philadelphia Section of the Society, has carried out settlement observations on one large new structure in Philadelphia. Thirty-three special leveling plugs (see Proceedings for September 1937, page 1360) were made for this purpose at Princeton University and installed both inside and outside of the building at the earliest possible stage of construction, and observations of settlement are being made periodically.

Conversion of Kinetic to Potential Energy in Expanding Conduits (Dr. F. T. Mavis). Tests on flow through a 3 to 5-in. sudden expansion have been completed. A comprehensive analysis of the photographic and statistical data obtained in experiments on this project has been made. The results obtained have been reported to the Committee by Mr. A. A. Kalinske. Some warping of the pyralin sections having affected the results, it is planned to make additional experiments with "Lucite" before publishing the results.

Traveling Waves on Steep Slopes (Prof. H. A. Thomas). The extensive motion pictures of these experiments are being studied, together with the other data obtained, with a view to issuing a comprehensive report by Prof. H. A. Thomas.

Phenomena of Intersecting Streams (Prof. M. P. O'Brien). A progress report on the results obtained with intersecting closed channels was submitted to the Committee by E. H. Taylor and Prof. M. P. O'Brien. Experiments were made on both combining and diverging flow. It is planned to continue the experiments with closed channels during the coming year.

Curves in Open Channels (Dr. C. A. Mockmore). The nature of the flow around bends has been investigated by means of a pitot tube and midget current meter as well as by photographing the movement of sawdust, confetti (for surface velocities), rice grains (bottom velocities), and drops of oil dye (interior). A mathematical analysis of the flow has been made giving results in general agreement with the observations. A report on the results was submitted to the Committee by Messrs. W. B. Matlock and A. E. Alspaugh.

Sedimentation at the Confluence of Rivers (Dr. Lorenz G. Straub). A number of motion pictures showing the nature of the sand movement in the experimental flumes at the intersection have been made. Experiments are now being conducted with a sand having grains fairly uniform in size.

Air Resistance to Flow of Water in Open Channels (Dr. Lorenz G. Straub). Considerable study has been given to this project and a suitable flume has been designed having steep adjustable slopes.

Simultaneous Flow of Liquids and Gases in Pipes (Dean F. M. Dawson). A long closed rectangular channel of transparent "Lucite" has been constructed for these experiments. Air and water will be supplied by means of a tank at the upper end and both measured by a tank at the lower end. Entrainment of air by water flowing down vertical drain pipes is also being studied.

Tension Tests of Large Riveted Joints. A grant of $500 was made in March to supplement funds available in the American Society of Civil Engineers' budget to make possible the publication in full in the Proceedings of the Society of a valuable article entitled "Tension Tests of Large Riveted Joints" by Raymond E. Davis, Glenn B. Woodruff, and Harmer E. Davis.

In all, about $7,800 was contributed by the Foundation during the year to the projects listed above. Contributions to other research activities brought the year's total of such disbursements to almost $34,000.

The activities of Engineers' Council for Professional Development, for which United Engineering Trustees acts as treasurer, are reported separately in this issue.

Activities of E.C.P.D. in 1939 Reviewed

Progress in Many Lines Reported at Seventh Annual Meeting

ENGINEERS' Council for Professional Development is entering its eighth year since its founding in October 1932. The seventh annual meeting, held in New York on October 20, not only gave evidence that the continuance of the Council is justified but also showed that it is alive to the challenge of new problems. Forty-three representatives, members of committees, secretaries, and staff assistants were present at the seventh annual meeting, which was held in the Board Room of the American Society of Civil Engineers.

In response to an invitation expressed by Dr. Webster N. Jones, the Council voted to hold its next annual meeting in Pittsburgh, on October 24, 1940. This will be the first meeting of the E.C.P.D. held outside New York City.

A number of foreign engineering associations, notably the Engineers' Guild of Great Britain and the Engineering Institute of Canada, as well as a number of other engineering organizations in the United States, have expressed interest in the work of the Council. The chairman was authorized to appoint appropriate committees to study and report on the question of the best means of cooperation with these bodies.

A memorial resolution was adopted expressing the profound regret of Council over the death of Dr. C. F. Hirshfeld. "As chairman of the preliminary organization group (of E.C.P.D.) he contributed to its ideals, its policies, its plans. As its chairman during its first and formative years, 1932–1936, he imbued it with high ideals of the engineers in our modern world. His varied experience as teacher, as consultant, as director of research, his participation in a score of engineering societies and scientific groups, his authorship of many books gave him a broad and rich experience. His powers of analysis and application, his imagination and trained intelligence, his intellectual courage and resourcefulness which produced notable achievement in engineering accomplishment, were applied in visioning the engineer of tomorrow. The Engineers' Council for Professional Development registers its obligations to the ideals and the leadership of Clarence Floyd Hirshfeld."

By a standing vote, the secretary was also instructed to prepare a memorial resolution on the death of Frank E. Winsor, a representative of the American Society of Civil Engineers.

Committee on Selection and Guidance of Engineering Students

Robert L. Sackett, M. Am. Soc. C.E., presenting the report of the Committee on Selection and Guidance of Engineering Students, reviewed the objectives of the committee as follows:

1. To encourage and improve counseling for high school students.
2. To urge the organization of committees of engineers, through their national societies, to assist high school authorities in guiding boys toward or away from engineering, depending on their qualifications.
3. To revise the publication, *Engineering: A Career—A Culture.*
4. To urge engineering schools to consider better methods of selecting promising students for engineering education.

During the year, educational journals of national, state, and local interest gave wide publicity to the efforts of E.C.P.D. to provide better information concerning engineering for high school boys, councilors, and teachers. Numerous requests came from junior colleges, from preparatory and high school principals, and from committees of engineers for suitable material and advice on methods and programs for guidance where students had expressed an interest in engineering. A considerable amount of literature has been distributed by the committee.

Attention was called to the unique and effective program in guidance inaugurated by the Iowa Engineering Society, which has a student correspondent in each of 200 selected Iowa secondary schools.

Many local engineering societies have established joint committees to cooperate with high school authorities in preparing and conducting programs, and the national engineering societies have been urged to encourage the formation of committees to cooperate in this work. Gratifying progress has been made and in no case of which E.C.P.D. is aware has such service been opposed by high school officers.

As an example of effective guidance work, the chairman described the work of the New York Engineers' Joint Committee on Student Guidance, which has had phenomenal success in obtaining the approval of the New York school authorities, and cooperating with them by conducting guidance programs at 16 high schools, with 1,977 boys present.

The pamphlet *Engineering: A Career—A Culture* has been under active revision, initially at the hands of Dean O. J. Ferguson and Prof. W. B. Plank, and since then with the assistance of many interested teachers and practicing engineers. The title of the pamphlet will be changed to *Engineering as a Career.* The proposed revision, still in mimeographed form, will be submitted to the governing boards of the participating societies for further criticisms and suggestions. Of the original 100,000 copies printed, 85,000 have been put to use, 7,500 of them during the past year.

Council also voted to commend the efforts of those engineering colleges which select their students with due consideration for the future of the engineering profession.

Committee on Engineering Schools

Karl T. Compton, retiring chairman of the Committee on Engineering Schools, presented a report covering the activities of that committee since its inception. Its general responsibility is to recommend "means of bringing about cooperation between the engineering profession and the engineering schools," while for its immediate objective it was instructed to "report to the Council criteria for colleges of engineering which will insure to their graduates a sound educational foundation for the practice of engineering."

"Upon its appointment the committee accepted as its first and major assignment the appraisal of engineering curricula toward the end that a single list of curricula could be prepared which would be generally accepted as authoritative."

"During the course of the accrediting program certain basic policies were developed by the committee and carefully adhered to. The committee recognized that curricula of varying standards

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New Officers of E.C.P.D.

As announced at the Seventh Annual Meeting

Chairman (reelected): J. P. H. PERRY, vice-president of Turner Construction Company, former Director, Am. Soc. C.E.

Vice-Chairman (reelected): R. E. DOHERTY, president of Carnegie Institute of Technology

Secretary: C. E. Davies, secretary of American Society of Mechanical Engineers

Assistant Secretary: George T. Seabury, secretary of American Society of Civil Engineers

Treasurer: United Engineering Trustees, Inc.

Chairmen of Committees

Engineering Schools: A. A. Potter, dean of engineering, Purdue University

Professional Recognition: C. F. Scott, professor of electrical engineering, Yale University

Professional Training: O. W. Eshbach

Junior Committee on Professional Training: J. C. Arnell

Student Selection and Guidance: R. L. Sackett, dean emeritus of engineering, Pennsylvania State College

New Members of Committee

Engineering Schools: R. E. DOHERTY, J. W. BARKER, E. L. MORELAND

Professional Recognition: C. R. BEARDSLEY

Student Selection and Guidance: G. B. THOMAS, A. R. CULLIMORE

Professional Training: (To be announced)

may be found in any one institution and that this fact required the accrediting of separate curricula rather than institutions as a whole. A second important principle was recognized in the decision to avoid all rigid standards; the program should not contribute toward a standardization and ossification of engineering education. It was further decided that the decisions of the committee would be preceded in every case by a visit of inspection by a competent group of engineers and educators so that qualitative, as well as quantitative, factors might be given appropriate consideration."

"By the end of October 1938, the number of engineering schools visited and acted upon had totaled 136, and the number of curricula reviewed had reached 678. During the twelve months since then, four new institutions representing a total of seven curricula have been inspected, and 74 curricula already provisionally accredited were reinspected. In addition nine curricula, rejected as a result of previous inspections, have been reinspected. To date 144 out of a total of 150 odd degree-granting engineering institutions have applied for inspection, and 687 curricula have been acted upon or are now under consideration."

STATISTICS ON THE ACCREDITING PROGRAM OF E.C.P.D.

From Its Inception, through October 20, 1939

Curricula acted upon by E.C.P.D.:

Accredited unconditionally	433
Accredited for limited periods	82
Not accredited	172
Total acted upon	687
Approximate number of engineering degree-granting institutions in the United States	155
Number of institutions inspected for accrediting	140
Number of institutions acted upon (October 20, 1939)	140
Number of institutions applying but inspection deferred	4
Number of institutions having one or more curricula accredited	118
Number acted upon having no curricula accredited	22
Number of varieties of curricula inspected	43
Number of varieties accredited	29

"In its initial program of inspection the Committee on Engineering Schools assembled a wealth of factual material on many aspects of engineering education in the United States. While an over-all study of the material thus assembled was not part of the program assigned to the committee, the committee recognized that the live and comprehensive data it had in its possession afforded exceptional opportunity for an analysis of the current status and trends of engineering education to supplement previous investigations."

With the generous help of the Carnegie Foundation for the Advancement of Teaching, which provided a grant of $10,000 for expenses, Dr. Dugald C. Jackson at the request of the committee undertook the study. His report is now on the press. "It is particularly appropriate that this material should be appearing at a time when the committee is completing the first stage of its program, namely, the initial accrediting of engineering curricula, and is entering upon the second stage of reinspection and maintenance of the accredited list."

"The initial job of accrediting has been accomplished; only a few institutions remain which have not applied for inspection. With the work of the first inspection and recommendation so nearly complete, the committee has already begun to direct its attention toward insuring the continued reliability of its list of accredited curricula, and in this direction lies the major activity of the immediate future."

"Reinspections of accredited curricula already scheduled for the next five years must be carried out systematically and the committee must keep itself informed about changing conditions in the accredited institutions. In many ways the maintenance of a reliable list is more difficult than the preparation of the first one; institutions will not be clamoring for reinspections and the initiative must be taken by the committee. If the program is to meet with ultimate success, however, this plan of continuing appraisal must be carried out assiduously."

It was inevitable that many related problems should arise in the course of the accrediting procedure. All those that came to the attention of the committee have been carefully examined and those which appeared clearly to fall within the purpose or the capacity of the committee have been studied at some length. For example, problems relating to evening and cooperative curricula, the apparent tendency of secondary schools inadequately to train students to enter engineering courses, and the extension of the advisory service of the committee to institutions have all been given continuing consideration.

In retiring from the chairmanship of the committee, Dr. Compton stated that he has "found the six years a profitable and exciting experience and one that has convinced him that the objectives and policies of the committee are sound and that its work is essential in any program to bring about cooperation between the engineering profession and the engineering schools."

COMMITTEE ON PROFESSIONAL TRAINING

Dean O. W. Eshbach presented the report of the Committee on Professional Training. Following the suggestion to which E.C.P.D. gave its approval last year, the committee has been formulating, with the help of the education committees of the constituent societies, an outline of topics for joint study. Among the items on which data are to be collected are post-college guidance, activities for junior members and an attempt to state a guiding policy and recommended functions for committees interested in the development of young engineers.

During the past year Walter C. Johnson, an instructor in electrical engineering at Princeton University and holder of the Robert Stewart Brooks Fellowship from the Princeton School of Engineering, encouraged by the E.C.P.D. Committee on Professional Training, undertook a first-hand study of the opportunities provided by industry for the breaking-in and training of young engineering graduates. While on this mission, Mr. Johnson traveled about 12,000 miles and interviewed many of the larger industrial organizations as well as some of the smaller ones. The study was later extended by means of a questionnaire. A summary of Mr. Johnson's observations was presented with the report of the Committee on Professional Training.

"One of the most important long-range problems of an industrial organization is the selection and development of new talent for future positions of leadership. Many industries, particularly those whose products are of a technical nature, have quite naturally turned to the engineering schools for many of their young employees, not only to fill the more purely technical positions, but with an eye to future executive work as well."

"One of the most effective methods of doing this is through a well-thought-out student training course. It is a mistake to assume that such instruction is necessary only in the larger companies, or that it need by very expensive. It is evident, however, that if the training course is to achieve all of its objectives with a minimum of time and expense, the student's needs must first be carefully analyzed, and the course itself must be just as carefully planned."

"The objectives of a reasonably complete student training program should include the following:

"1. Give the student practical experience.

"2. Acquaint the student with the organization and business administration of his company.

"3. Acquaint him with the company's products and their application, problems of manufacture, etc.

"4. Help him select a job for which he is fitted.

"5. Further the student's technical training."

"The usual argument against training is its cost, but an adequate course of instruction need not be expensive even for the smaller companies if it is well planned. A complete training course should include both an experience program and an instructional program, with the latter providing training in the organization and business administration of the company, instruction in the company's products and their problems of manufacture and application, and for those students who show exceptional technical ability both the opportunity and encouragement for continuing their technical education, perhaps in company schools, or in cooperation with a local college or university."

"Present industrial training courses are particularly weak in business and organizational training, and relatively little attention is paid to the continuation of the student's habits of study and to

his opportunities for additional technical education. These deficiencies are important in the small as well as in the large organization. Their remedy is a matter of planning rather than expense, and the necessary effort will, in time, be amply repaid in many ways."

COMMITTEE ON PROFESSIONAL RECOGNITION

Chairman Charles F. Scott, presenting the report of the Committee on Professional Recognition, stated that although it is the duty of the committee "to develop methods whereby those engineers who have met suitable standards may receive corresponding professional recognition," there still remain perplexing problems in determining these suitable standards and the methods of finding out when individual engineers have met them. This objective implies that "professional recognition" signifies a definite field into which admission is granted.

The committee continues its studies in the whole field and reports helpful assistance by cooperation from various units in the constituent bodies and other organizations.

Chairman Scott suggests that "The societies might profitably crystallize more definitely their ideas of the profession, comparing their ideals and emphasizing what is common rather than their differences. They may well inquire how much the unity and the solidarity of the profession of which they have been the sponsors has suffered through their individual disregard of conformity; and they may also consider what action is expedient for the future."

"Our engineering schools should inculcate the professional ideal in their students.... Engineering students should get a perspective view of engineering in modern life; of the influence of past engineering achievements in shaping the present, and of the ways it is contributing to our present life. They should begin to understand the various fields open to engineering graduates and the qualities which contribute to success. They should develop professional methods and attitudes—they are not merely students of engineering subjects but they are student engineers—actually prospective engineers in the early stage of their career, already thinking and working as engineers think and work.... It is a function of faculty and engineers and engineering societies to aid students in the study of their future fields of work and in cultivating a professional interest and attitude."

"Engineering is in a state of evolution. Its development merits the serious consideration of the various groups which constitute E.C.P.D., both in terms of their individual attitude and in their coordination. In general a profession typifies or represents those who compose it. That is, it depends upon the quality of its members. Our primary concern then is with the quality and ideals of those who will constitute the profession."

The committee reported that it had tabulated the number of persons admitted to professional grades of membership in the constituent societies during 1938, to see how many were registered in the various states. It found that one-half of the applicants to the corporate grades of the American Society of Civil Engineers were registered in at least one state. In the corresponding grades of the American Institute of Electrical Engineers one-third were registered; of the American Society of Mechanical Engineers, one-fourth; of the American Institute of Chemical Engineers, one-sixth; and of the American Institute of Mining and Metallurgical Engineers, one-eighth.

As one of its current projects, the committee has sponsored several meetings of a group of representatives from the admissions committees of the constituent societies to study further the advisability and practicability of greater uniformity in membership grades.

In accordance with the annual custom, a dinner at the Engineers Club followed the Council meeting. The speakers were Dr. A. A. Potter, dean of engineering, Purdue University, and the new chairman of the Committee on Engineering Schools; Donald S. Bridgman, staff assistant of the American Telephone and Telegraph Company; Dr. E. S. Burdell, director of Cooper Union; and R. C. Muir, vice-president in charge of engineering, the General Electric Company of Schenectady.

Topics Announced for 1939–1940 Mead Prize Papers on Ethics

With the approval of Dr. Mead, donor of the Daniel W. Mead prizes for papers on ethics, the Committee on Professional Conduct has announced the following topics for papers to be submitted in the competition which will close June 30, 1940: for the Junior prize, "Ethics for Sales Engineers"; for the Student prize, "Ethics for Engineering Students."

The rules for the competition were printed on page 674 of the November issue.

Change in CIVIL ENGINEERING Reprint Policy

BEGINNING with the January 1940 issue, a new policy with regard to reprints of CIVIL ENGINEERING articles will go into effect. Two principal changes are involved:

1. In lieu of the complimentary reprints that it has been customary to give each author, complimentary copies of the entire issue containing his contribution will be presented. Reprints of individual articles will not be made unless ordered in quantities of 100 or more prior to publication.

2. The edition of CIVIL ENGINEERING will be increased sufficiently to provide a reserve stock of each issue to meet the occasional demand for single copies of articles after publication. These "back copies" will be available at the regular price of 50 cents each.

It is expected that these changes will result in a material saving in publication costs, without sacrifice of service either to authors or to the membership at large.

Index for 1939 in This Issue

AT THE END of this issue appears the index for the current volume of CIVIL ENGINEERING, covering the issues from January through December 1939. As a matter of convenience it is included as a separate printed form, which can be removed intact by loosening the binding staples. It thus becomes available for filing or for binding in the yearly volume. With the latter idea in mind, the first page of the index has been designed to make a title page for the bound volume.

The index is as complete as it has been possible to make it in the space available. Every article and item has been included, a large percentage of them appearing under two or more headings, so that any desired article can be located quickly even though the searcher may recall only its general subject matter.

Separate reprints of the index may be had from Headquarters, 33 West 39th Street, New York, N.Y., at 15 cents a copy.

John Fritz Award to the Late Clarence Floyd Hirshfeld

POSTHUMOUS award of the John Fritz Medal to Clarence Floyd Hirshfeld, late chief of research for the Detroit Edison Company, was unanimously voted by the Board of Award on November 3, 1939. Mr. Hirshfeld died on April 19, 1939, after consideration of his candidacy had begun.

The medal is awarded annually, by a board composed of 16 representatives of the four Founder Societies, for notable scientific or industrial achievement. Mr. Hirshfeld's citation was "for notable leadership through research and development in power generation and electric traction, and for being a great teacher and friend of men both young and old."

The Milo S. Ketchum Award

IN the November issue of CIVIL ENGINEERING it was incorrectly stated that the Milo S. Ketchum Award, which in 1939 went to James Howard Lear, of the University of Colorado, was made by the Colorado Section. It should be noted that the Milo S. Ketchum Award is made by the civil engineering staff of the University of Colorado, and that the award is made possible by the friends of the late Milo S. Ketchum and those who graduated from the University of Colorado in civil engineering during the time that he was dean there.

Three Local Sections Have Large Fall Meetings

Unusually successful fall meetings were enjoyed by three Local Sections—Mid-South, Tennessee Valley, and Texas—in the southern part of the country.

More than 150 members and guests of the Mid-South Section met in Greenville, Miss., on November 6 and 7 for a two-day program, which included talks and papers dealing principally with the design and construction of the bridge now being built across the Mississippi a short distance below Greenville. At the opening session M. C. Smith, mayor of Greenville, delivered an address of welcome, and W. W. Zass, president of the Mid-South Section, responded for the Section. The first speaker on the technical program was John A. Fox, field director of the Mississippi Valley Association, who gave a brief historical résumé of the Greenville Bridge project.

At noon the gathering adjourned for an informal luncheon at the Hotel Greenville, while the wives of the visiting engineers were entertained at a luncheon at the Greenville Country Club. Speakers heard at the afternoon session were R. N. Bergendoff, assistant engineer for Ash-Howard-Needles and Tammen, of Kansas City, Mo., who discussed the selection of the site and preliminary examination; E. E. Howard, who spoke on the problems involved in designing and constructing the project; F. V. Ragsdale, Memphis contractor, whose topic was "Problems in Approach Construction"; Oscar A. Zimmerman, chief engineer of the Massman Construction Company, who spoke on "Pier Construction and Main Spans"; R. A. Harris, chief engineer of the Mississippi State Highway Department, and J. M. Page, senior highway engineer for the Public Roads Administration, who gave a joint discussion on the highway approaches to the bridge; and Charles A. Branch, of the Public Works Administration, whose subject was "General Relations Between the Public Works Administration and the Greenville Bridge Project."

In the evening a banquet was held in the ballroom of the Hotel Greenville. The principal after-dinner speaker was Harvey C. Couch, president of the Arkansas Power and Light Company, who expressed his conviction that, largely as a result of activity on the part of the engineering profession, the territory in the vicinity of Greenville will assume a new economic importance to the nation. A floor show and dancing rounded out the evening's entertainment.

On the second day there was a business session, followed by an inspection trip to the bridge site. D. D. Brown, resident engineer for Ash-Howard-Needles and Tammen, conducted the tour of inspection, and afterwards the group was entertained at lunch by Mr. Ragsdale.

Texas Section Celebrates Its Twenty-Fifth Anniversary

A two-day meeting of the Texas Section was held in Fort Worth, Tex., on October 20 and 21, with 125 present. On the evening of the 19th a number of members gathered in Fort Worth for the occasion enjoyed a pleasant social evening at the Texas Hotel. The meeting itself was called to order on the 20th by Marvin C. Nichols, president of the Fort Worth Branch of the Texas Section. M. D. Evans, mayor pro tem of Fort Worth, then welcomed the meeting to the city, while L. R. Ferguson, president of the Texas Section, responded for the group. The main speakers on the technical program presented that morning were Charles P. Williams, project engineer for the Ambursen Engineering Corporation at Mineral Wells, Tex., who gave a paper on the Possum Kingdom Dam and power house; and John B. Alexander, principal engineer in the U.S. Engineer Office at Denison, Tex., whose subject was the Denison Dam. J. H. Straton and O. N. Floyd discussed the latter paper.

At noon there was a luncheon at which Field Secretary Jessup spoke. After conveying the greetings of the Society, Mr. Jessup discussed the subject of increasing the membership of the Society. The speakers at the afternoon session were George M. Bull, regional director of Region No. 5 of the Public Works Administration, Fort Worth, who presented a paper on the "Development of Denver's Municipal Water Supply"; and Walter W. Cook, regional project adviser for the U.S. Housing Authority at Fort Worth, who spoke on slum clearance and low-rent houses. Various aspects of Mr. Bull's subject were discussed by Uel Stephens and E. W. Fassett, and Homer Hunter and Oscar Koch discussed Mr. Cook's paper.

Members and Guests of the Mid-South Section Visit Site of Mississippi River Bridge at Greenville

The dinner dance held that evening was enlivened by an amusing floor show. On Saturday morning there was a breakfast for Student Chapter members attending the meeting. Mr. Jessup addressed the group, and later the students took up the business of adopting a constitution for the Texas Student Chapter Conference.

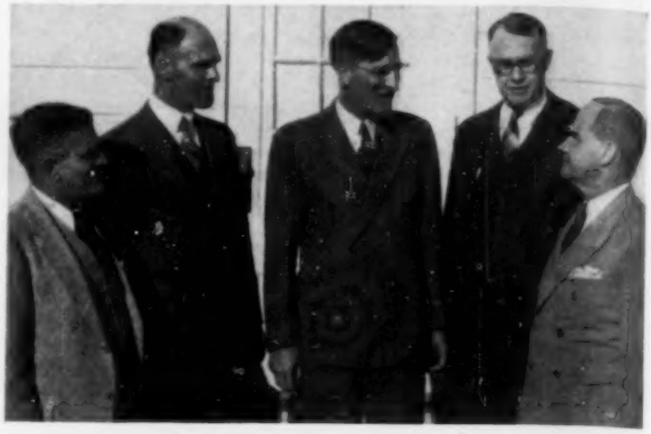
In calling to order the Saturday morning technical session, Vice-President John H. Bringhurst reminded the group that the Texas Section was celebrating its twenty-fifth anniversary and stated that the next speaker would be one of the charter members of the Section. This was Maj. John B. Hawley, consulting engineer of Fort Worth, whose subject was "The Settlement Factor in Earth Dams." Major Hawley's associate, Homer Hunter, gave a supplementary paper. The discussers were O. N. Floyd and S. W. Freese. The final paper on the technical program was given by E. V. Spence, city manager of Big Spring, Tex., who presented a brief history of the Big Spring water supply and showed two reels of motion pictures.

A business session concluded the meeting. At this time the suggestions of the nominating committee for new officers were adopted with the following results: R. J. Cummins, president; E. C. Woodward and Hans Helland, vice-presidents; and John A. Focht, secretary.

It is of interest that the Texas Section has established two new Branches—the Brazos County Branch and the Lower Rio Grande Branch. The officers of the Brazos County Branch are S. R. Wright, president; J. W. Aston, vice-president; and F. J. Benson, secretary. Those of the Lower Rio Grande Branch are A. Tamm, president; W. Q. Washington, vice-president; and V. R. Brady, secretary.

Tennessee Valley Section Meets at Watts Bar

On October 28 members of the Tennessee Valley Section met at Watts Bar, Tenn., for their sixth annual fall meeting. Following a business meeting in the morning, there was a luncheon for members and their guests. A symposium on the Watts Bar project constituted the technical program. An introduction and general summary of the project was presented by Lee G. Warren, project engineer. Then Harry A. Hageman, chief design engineer for the Tennessee Valley Authority, discussed the design aspects of the project. He was followed by George K. Leonard, construction engineer for the Tennessee Valley Authority, whose topic was



GROUP AT FALL MEETING OF TENNESSEE VALLEY SECTION
Reading Left to Right: C. B. Coe, Secretary of the Section; Erwin Harsch, Vice-President; A. S. Fry, President; C. E. Nichols, Vice-President; and Lee G. Warren, Former President

"Construction Engineering Features." A talk on "Construction Phases and Program" by Fred C. Schlemmer, construction superintendent, completed the technical program.

The business meeting was then resumed for the purpose of electing officers for the coming year, the results being as follows: A. S. Fry, president; C. E. Nichols, Erwin Harsch, J. L. Lamson, and P. B. Hill, vice-presidents; and C. B. Coe, secretary and treasurer.

A tour of the dam site under the auspices of TVA guides completed the afternoon. Ladies not wishing to make this trip were entertained at bridge.

Fourth Anniversary of Publicity

THE SOCIETY'S publicity program will attain its fourth anniversary in January. How the program was initiated and how it has progressed during the succeeding years is an interesting story.

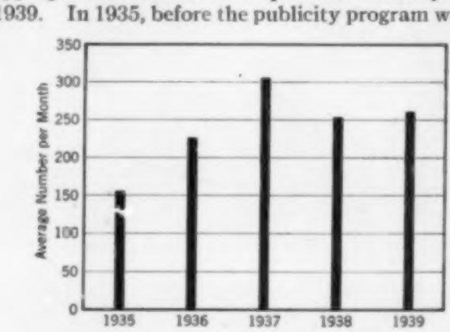
For some time prior to January 1936, the Board of Direction had considered the advisability of instituting a public relations program on a large scale. The Society's Committee on Public Education was functioning in a limited way, because of small appropriations and the apparently overwhelming task of trying to educate an influential part of 130 million people to the value to them of civil engineers. The job looked enormous, and the Board, believing that the greatest good could be achieved by instituting a full-fledged publicity program, made an increased appropriation and authorized the employment of a highly trained Publicity Director to develop appropriate and practicable ways and means of informing the public of the work of civil engineers to the end that the profession, the Society, and the public would benefit.

One of the first tasks undertaken by the new Publicity Director was to publicize the Annual Meeting of the Society in 1936. His next was to compile a "Publicity Manual." This was issued in June of 1936 and distributed to the presidents, secretaries, and publicity chairmen of all Local Sections, and to the Student Chapters of the Society. In 14 short chapters, this Manual tells in a simple, forthright manner how, when, why, and what releases should be sent by civil engineers to the newspapers. It gives many helpful hints for increasing the civil engineers' relations with the public, and is admirably suited to the needs of all Local Sections. It stresses throughout two basic rules.

1. Have something to say.
2. Say it simply.

The thought behind this plan was—first develop in the public consciousness the concept of the American Society of Civil Engineers as a large national organization embodying men of high caliber; then assign to the Local Sections the job of making the activities of those men known to their local public. For a period, therefore, the program consisted of a centralized individual effort, supplemented casually by local individual efforts.

The accompanying graph depicts the average number of newspaper clippings received at Headquarters monthly from 1935 through 1939. In 1935, before the publicity program was initiated,



AVERAGE NUMBER OF NEWSPAPER CLIPPINGS PER MONTH ABOUT THE SOCIETY AND ITS MEMBERS

the number was small. When the program was initiated in 1936 there was a decided increase, and the number increased still more the following year. In 1938, with the program still centralized, but with the Publicity Director engaged on a part-time basis, the number of clippings decreased somewhat. Most of the press releases in that year were of a national character, using the meetings of the Society and the papers in the Society's publications as a basis.

Towards the close of 1938 it was decided that the time had come for a systematized decentralization of the public relations program. Local Sections were asked to appoint publicity chairmen. A 4-page pamphlet entitled *Headlines*, prepared at Headquarters, was sent to the presidents, secretaries and, as soon as appointed, the

publicity chairmen of all Local Sections. Within a few months, 40 chairmen were listed. In January of 1939, even the part-time services of the Publicity Director were discontinued and reliance was placed wholly upon the local publicity chairmen, with but a minimum of assistance from the Headquarters staff.

Headlines, prepared monthly by the staff, has the character of an intimate house organ, addressed specifically to stimulation of local publicity, and limited in circulation. With this character, it may convey, by example, by precept, and by inference to all participants in the program, a picture of successes, or of failures, in newspaper publicity. Never in the history of the Society, with but one exception of long standing, has there been so nearly universal an acceptance of a suggested program to be carried out by the Local Sections. At this moment, 59 of the 63 Local Sections have publicity chairmen.

The press is not the only field upon which the publicity program has entered. Radio has been used as a medium of informing the public of the work of civil engineers. In 1937, a radio series was given each week for 18 weeks for a quarter-hour period over WNYC, New York's municipal radio station. These talks were designed to cover almost every phase of civil engineering work and to give the lay public clear pictures of what the civil engineer does. (Copies of these talks are available to Local Sections on request.) In 1939, short programs were broadcast from both the Spring Meeting and the Annual Convention—the former over a 32-station hook-up and the latter over a nation-wide hook-up.

The total cost to the Society of the publicity program through the four years has amounted to approximately $18,000. The largest, $6,755, was spent in 1937, and the smallest, $2,500, to be spent in 1939—yet 1939 is the second most fruitful year. What is the answer? Simply this—first, learning how to do the job; and second, evolution from individual centralization into the present system by which 59 publicity chairmen now handle news releases locally, their work assisted and periodically appraised through the medium of the Headquarters staff. With the work distributed more or less uniformly throughout the Society, the efficacy of the publicity program has been increased many times over—for each Local Section knows best the way it desires its public relations program carried out, and is there on the spot to see that it is done!

Appointments of Society Representatives

JOSEPH JACOBS, M. Am. Soc. C.E., has been appointed chairman of a Society committee to set up criteria for rating papers for prizes. The other members of the committee are C. B. BURDICK, W. W. HORNER, C. W. SHERMAN, and HENRY J. SHERMAN, Members Am. Soc. C.E.

R. C. MARSHALL, JR., M. Am. Soc. C.E., has been appointed the Society's engineering representative to confer with the U.S. Housing Authority concerning engineering fees.

EZRA B. WHITMAN, M. Am. Soc. C.E., has accepted an appointment to represent the Society on the Joint Conference on Standard Construction Contracts of the Associated General Contractors of America.

In and About the Society

THE Centro Argentino de Ingenieros, whose headquarters are in Buenos Aires, has recently been added to the list of engineering societies throughout the world which exchange courtesies with the American Society of Civil Engineers.

* * * *

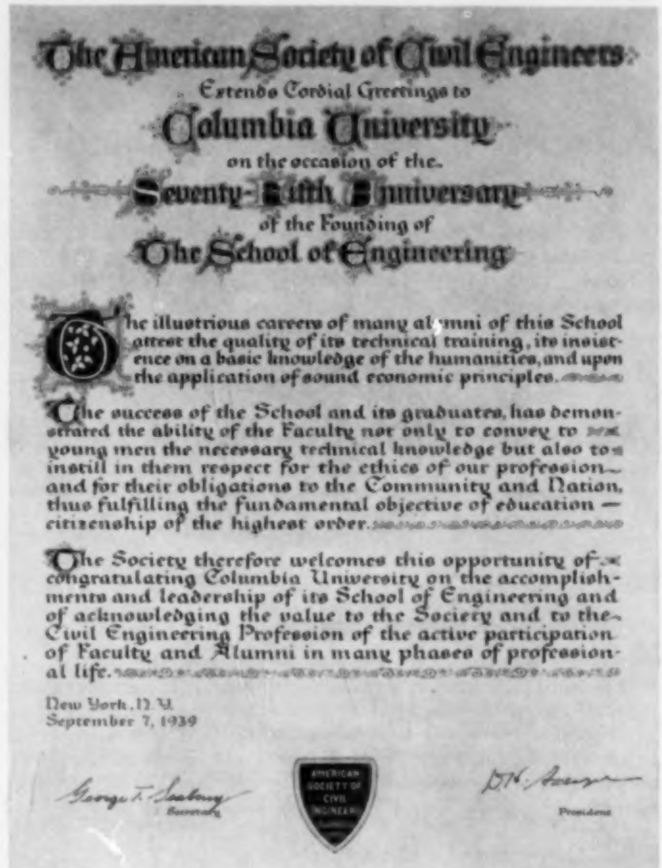
NEWCOMER in the list of Local Section publications is the *North Carolina Civil Engineer*, a quarterly of which Vol. I, No. 1, appeared in September 1939. With a page size only slightly smaller than that of CIVIL ENGINEERING, and a two-color cover, it is attractive in appearance and well edited. The first issue carries reprints of addresses and papers given before the North Carolina Section, and news of Section activities and individual members.

* * * *

JUNIORS in Pittsburgh gather every Wednesday for luncheon in a centrally located restaurant. A table is reserved for them at no extra charge, and the "get-togethers" are purely informal.

Society Joins in Celebration at Columbia University

GREETINGS of the Society have been extended to Columbia University on the occasion of the seventy-fifth anniversary of the founding of its school of engineering. The greetings take the form of an engrossed testimonial, and as this issue went to press plans



The American Society of Civil Engineers
Extends Cordial Greetings to
Columbia University
on the occasion of the
Seventy-Fifth Anniversary
of the Founding of
The School of Engineering

The illustrious careers of many alumni of this School attest the quality of its technical training, its insistence on a basic knowledge of the humanities, and upon the application of sound economic principles.

The success of the School and its graduates, has demonstrated the ability of the Faculty not only to convey to young men the necessary technical knowledge but also to instill in them respect for the ethics of our profession and for their obligations to the Community and Nation, thus fulfilling the fundamental objective of education — citizenship of the highest order.

The Society therefore welcomes this opportunity of congratulating Columbia University on the accomplishments and leadership of its School of Engineering and of acknowledging the value to the Society and to the Civil Engineering Profession of the active participation of Faculty and Alumni in many phases of professional life.

New York, N.Y.
September 7, 1939

AMERICAN SOCIETY OF CIVIL ENGINEERS

ENGROSSED TESTIMONIAL PRESENTED BY THE SOCIETY TO COLUMBIA UNIVERSITY

were being completed for its presentation by President Sawyer at a convocation on November 27.

Similar greetings were also to be presented at that time from the Institution of Civil Engineers and the Engineering Institute of Canada. The ceremonies were planned originally as a feature of the British American Engineering Congress, which was to have been held last September.

The greetings of the Institution of Civil Engineers called attention to the leading part taken by the University "in promoting knowledge in engineering science and in recognizing the need for the creation and maintenance of a high standard in engineering education, thereby assisting to preserve that eminent place which American engineers have won in the field of practical achievement." It expressed the wish that the engineering school might long prosper "and continue to provide for those graduating into the profession a liberal training in the art and practice of engineering."

On November 21, the Metropolitan Section of the Society joined with the department of civil engineering of the University in another anniversary celebration event—a joint meeting on "Research in Engineering," held in the Pupin Laboratories. The program, arranged in cooperation with the Columbia Engineering Schools Alumni Association, included addresses by three members of the Society, Leon S. Moisseiff ("Research in Structural Engineering"), Walter E. Spear ("Research in Hydraulic Engineering"), and Carlton S. Proctor ("Research in Soils and Foundation Engineering"). The addresses were followed by an inspection of various laboratories of the department, and a collation and social hour.

THE COMMITTEE ON PROFESSIONAL OBJECTIVES MEETS IN KANSAS CITY

This Picture, Taken at the Session on October 30, Includes (Seated, Left to Right) Ivan C. Crawford, Frederic Bass, Enoch R. Needles, (Chairman), and (Standing, Left to Right) Henry L. Fruend, W. W. DeBerard, A. M. Rawn, Robert B. Brooks, and Field Secretary Jessup

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies in 40 States

COMMITTEE HEARS CRITICISM OF CIVIL SERVICE

MANY SUGGESTIONS for the improvement of the federal civil service were presented at a public hearing held November 1 and 2 in Washington by the President's Committee on Merit System Improvement, which is now preparing a report that is expected to recommend the inclusion of higher grades of professional employees within the classified civil service system, as well as other changes.

The committee, which is headed by Supreme Court Justice Stanley Reed, includes in its membership Gano Dunn and Gen. Robert E. Wood as representatives of the engineering professions and of business, respectively, as well as a number of high government officials. It was formed by President Roosevelt last February and has been studying the problem since that time. The submission of a final report is anticipated in the near future.

Of the many persons who presented testimony at the hearing only one, General Counsel D. W. Robinson, Jr., of the Federal Power Commission, opposed the further extension of the merit system. It was Mr. Robinson's contention that because of the peculiar requirements of his agency it could do a better job of selecting its legal staff than could the Civil Service Commission. All other witnesses supported the merit system in principle, but most of them submitted specific criticisms of the manner in which it is now functioning, and some recommended material modification of its procedure in recruiting employees for the more responsible positions. A representative of the Department of Agriculture, for example, suggested that its scientists and other experts be selected by joint boards made up from the Civil Service Commission, the Department itself, and one or more outside experts in the specific field involved.

Complaints directed at the administration of the present system may be briefly summarized as follows: Its examinations and lists are too general; too much time is consumed in the preparation of examinations, grading, and the compilation of eligible lists; registers are frequently too old; classification of jobs looks more to the number of subordinates controlled than to the real responsibilities of the position; present promotion and transfer procedure is inadequate; more attention should be paid to the training of employees for promotion. (Those who attended A.E.C.'s Annual Assembly last January will remember that at that time a representative of the Civil Service Commission recognized the validity of similar criticisms, but contended that their remedy was largely in the provision of more personnel and funds.)

Provisions of basic civil service law that came in for criticism included the state quota system and the preference granted to war veterans in grading applicants.

PLAN PAN AMERICAN SCIENTIFIC MEETING

Preliminary plans for the eighth American Scientific Congress, to be held in Washington May 10 to 14, 1940, have been announced by the Department of State following the dispatch of invitations to participate to the governments of all American republics affiliated with the Pan American Union. An organizing committee has already been named, headed by Under Secretary of State Sumner Welles and composed of a number of distinguished heads of scientific and governmental bodies, including Dr. C. G. Abbot and Dr. Alexander Wetmore of the Smithsonian Institution; Dr. Isaiah Bowman of Johns Hopkins University; Dr. Vannevar Bush of the Carnegie Institution; Dr. Ross G. Harrison of the National Research Council; Dr. James Brown Scott of the Carnegie Endowment for International Peace; and Dr. Leo S. Rowe of the Pan American Union.

At a recent meeting of this organizing committee it was decided to divide the Congress into eleven sections, each to be in charge of a chairman to be assisted by a vice-chairman and a section committee, which will soon be selected. The sections will cover, respectively, the anthropological sciences; the biological sciences; the geological sciences; agriculture and conservation; public health and medicine; physical and chemical sciences; statistics, history and geography; international law, public law, and jurisprudence; economics and sociology; and education.

Forecast for December "Proceedings"

CHANNELIZATION OF MOTOR TRAFFIC
By Guy Kelcey, M. Am. Soc. C.E.
Describes arrangements for confining movements of vehicles to definite lanes.

PRESSURE MOMENTUM THEORY APPLIED TO THE BROAD-CRESTED WEIR
By H. A. Doeringsfeld and C. L. Barker, Assoc. M. Am. Soc. C.E.
Presenting data to check a formula for flow over a weir, and through the sharp-edged entrance to flumes from reservoirs, on the basis of the conservation of momentum.

WATER SUPPLY ON THE UPPER SALT RIVER, ARIZONA
By John Girand, Assoc. M. Am. Soc. C.E.
Methods used to determine economical storage requirements and power outputs of a proposed hydroelectric plant.

PHYSICAL LAWS THAT CONTROL THE BEHAVIOR OF GROUND WATER
By C. F. Tolman and Amy C. Stipp
Comparison of physical laws and legal rules regulating ground-water supply.

MINIATURE SYSTEM OF FIRST-ORDER ALINEMENT AND TRIANGULATION CONTROL
By F. W. Hough, M. Am. Soc. C.E.
Suggestion for controlling variations in alinement across dam sites, fault lines, etc.

NORRIS DAM CONSTRUCTION CABLEWAYS
By R. T. Colburn, M. Am. Soc. C.E. and L. A. Schmidt, Jr., Assoc. M. Am. Soc. C.E.
Reviewing the design, erection, operation, and tests of a successful construction plant.

Reclamation Combined with Relief

Approval by President Roosevelt of a plan for the construction of the Buford-Trenton irrigation project in western North Dakota puts into effect a new policy in land reclamation under which relief labor will be contributed by the federal government to such work when special considerations are found to warrant such action.

Hitherto the policy of the Bureau of Reclamation has been to require contracts providing for the repayment, normally over a 40-year period, of all costs of constructing a proposed project before work would be undertaken. Under the new policy, however, the construction costs will be paid jointly by WPA and from a special $5,000,000 reclamation fund voted by the last Congress, to be repaid by water users only to the extent that they can afford, as determined by an economic study of conditions. For the Buford-Trenton project, this repayment has been set at $630,000 of the total cost of $1,500,000.

The modified plan has evolved from recommendations made by the Great Plains Committee, which made a special study of the "dust bowl" area after the drought of 1936. A Bureau of Reclamation study of Williams County, in which the newly approved project is located, points out that rainfall has been subnormal every year since 1929, 65 per cent of the farms are delinquent in tax payments, harvested acres have decreased by more than 400,000, animal population has been reduced over 50 per cent, and 15,000 of the 18,000 population is being supported by various forms of relief. Construction of the reclamation project will not only provide needed employment but will also do much to stabilize agriculture and livestock production in the neighboring area by providing supplementary feed for animals grazing on non-irrigated lands.

Major Reports Issued

Engineers and others interested in the broader aspects of economic problems relating to national resources will find much of interest in two comprehensive studies recently published by the National Resources Committee or, as it is now termed, the National Resources Planning Board. These deal, respectively, with the basic structure of the American economy and with energy resources of the United States. Containing 396 and 435 pages, respectively, each of these volumes is obtainable from the Superintendent of Documents, Washington, D.C., at $1.

The Structure of the American Economy (Part 1) is termed by the Committee "the first major attempt to show the interrelation of the economic forces which determine the uses of our national resources." It is essentially a qualitative and quantitative study (in so far as statistics are available) of the structure of the American economy for the purpose of clarifying the complicated picture and stimulating the development of possible solutions to economic ills.

The examination falls into three main classifications which are not mutually exclusive, but which picture the economic structure from different aspects. The first considers economic bases for production—the wants calling for satisfaction and the resources available to meet these demands. The second discusses the structure of production—geographical, functional, and financial. In the third part the actual organization of human beings to translate resources into consumption are examined, with particular emphasis upon distribution and administration.

Energy Resources and National Policy is limited, as the title indicates, to a narrower field, but goes further in that it includes findings and recommendations for future government policy. The bulk of the volume is devoted to an economic analysis of this country's energy resources—coal, oil, gas, and water power—with a discussion of the evolution of public policies relating to conservation and regulation. The balance of the book is devoted to the consideration of public policy as it should be shaped in the future in respect to each of the major energy resources.

While the general findings of the Committee were transmitted to Congress several months ago, the full text of the report has not hitherto been available.

Railroads Charged with Hampering Trucks

Whether or not a policy of refusing to set up joint rates and joint billing arrangements with trucking companies constitutes a violation of the anti-trust laws will be decided by a civil suit brought by the Department of Justice against the Association of American Railroads, its officers, and its 236 member lines. The root of the contention is a resolution passed by the board of directors of the association June 25, 1937, containing a declaration of policy to the effect that the interests of both the railroads and the public would be enhanced if railroad managements would refrain from establishing joint rates with truck or bus lines that would result in the invasion of the territory of another railroad. The Department of Justice characterizes this action as restraint of trade, while the Association states that it is merely a declaration of policy and that there has been no attempt to enforce its provisions against member roads that chose to follow the proscribed course.

Slum Projects Save Interest

By the simple expedient of resorting to private loans to carry slum-clearance housing projects through the major part of the construction stage, the U.S. Housing Authority expects to make a material saving in its operations. Under the law which created it, USHA loans 90 per cent of the cost of a specific project to the local housing authority which sponsors it, charging from 3 to $3^1/_4$ per cent interest. It has been found possible, however, to finance during the period of construction by short-term private loans at a saving of about 2 per cent, deferring the issuance of the higher-interest, long-term bonds until the project is near completion. The plan, when applied to the entire program, is expected to mean a saving of about $15,000,000 during the current year.

Building Practices Probed in Six Cities

Grand juries in a number of larger cities are now considering charges brought by the Department of Justice that supposedly illegal practices are resulting in unnecessarily high construction costs. The drive, which has been under way for several months but has just reached the stage of actual prosecution, springs from what the Department terms an unparalleled series of complaints originating among architects, contractors, labor groups, real estate firms, and home owners.

In Pittsburgh, 13 corporations and 45 individuals have already been indicted on charges of conspiring to defraud the government. The charge is that the defendants arranged bids for the electrical work on a federally financed hospital so as to assure an award to a firm selected by the local association of electrical contractors. In St. Louis, a federal grand jury has indicted William L. Hutcheson, president of the United Brotherhood of Carpenters and Joiners of America, and three other union officials, on the charge that they coerced an employer to violate a contract with one group of employees in order to replace them with another. Other cases are pending in Cleveland, San Francisco, New York City, Detroit, Chicago, and Los Angeles.

Alaska Road Approved

General approval as a "worthy and feasible" project has been given to the proposed international highway through British Columbia to connect the Pacific Northwest with Alaska by a special commission appointed to review the project. A preliminary report to this effect has been transmitted to the Department of State by Representative Magnussen of Washington, chairman of the Commission. Definite recommendations as to route, cost, and method of financing have yet to be released.

A.E.C. Aims Materialize in Recent Legislation

An analysis of selected legislation enacted by the first session of the 76th Congress, recently issued by the National Resources Planning Board, reveals several instances in which principles for which American Engineering Council has long contended have been accepted by our national lawmakers.

The most important of these is the reorganization of the executive department of the federal government, which brings together under one head—Federal Works Administrator John M. Carmody—all public works activities not carried on as an incident to the work of regular governmental agencies. In effect, if not in name, this brings to fruition Council's long-standing recommendation for the creation of a federal Department of Public Works, voiced in 1920 at the first meeting following Council's organization, and since frequently reiterated. In 1933 Council submitted a report to a representative of President Roosevelt containing detailed recommendations for the consolidation of public works activities, many of which have lately been put into effect. More recently, during the preparatory work which led up to the introduction and final passage of the Reorganization Act, Council actively cooperated with both the President's Committee on Administrative Management and the Brookings Institution, engaged to survey federal activities by the Joint Congressional Committee on Reorganization.

Another change effected under the Reorganization Act, the attachment of the National Resources Committee to the White House Executive Office under the new title of National Resources Planning Board, is a long step toward a second long-time objective of Council, the systematic planning of public works as a cushion to fluctuations in the business cycle. As early as 1922 Council indorsed a bill for this purpose, and at frequent intervals since then it has supported other similar measures. In 1934, creation by executive order of the National Resources Board (later changed to National Resources Committee) tentatively accepted this principle as a function of government, but on a year-to-year basis. The transfer of the committee's functions to the executive office gives it a greater degree of acceptance as a presumably permanent agency of the federal government.

Of more limited application, but of considerable importance to engineers and technicians in the government service, is a provision in the Treasury-Post Office Appropriation Act authorizing the government to defray the cost of travel of an employee transferred from one official station to another. Since 1925 Council has consistently advocated the revision of governmental travel regulations to conform more closely to established corporate business practice. Much still remains to be accomplished, but the provision cited is a step in the right direction.

Washington, D.C.
November 10, 1939

News of Local Sections

Scheduled Meetings

ALABAMA SECTION—Annual meeting at the Tutweiler Hotel, Birmingham, on December 8, at 7:30 p.m.

BUFFALO SECTION—Annual meeting on December 12.

CINCINNATI SECTION—Dinner meeting in the Student Union Building, University of Cincinnati, on December 12, at 6:30 p.m.

COLORADO SECTION—Dinner meeting at the University Club on December 11, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Dayton Engineers Club on December 18 at 12:15 p.m.

GEORGIA SECTION—Luncheon meeting at the Atlantan Hotel on December 11, at 12:30 p.m.

KANSAS CITY—Annual dinner meeting at the University Club on December 7, at 6:30 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on December 13, at 6:30 p.m.

MARYLAND SECTION—Dinner meeting at the Engineers Club on December 12 (25th anniversary dinner).

METROPOLITAN SECTION—Technical meeting in the Engineering Societies Building on December 20, at 8 p.m.

NORTHEASTERN SECTION—"Old Home Night" on December 6.

NORTHWESTERN SECTION—Dinner meeting at the Town and Country Club on December 14, at 6:15 p.m.

PHILADELPHIA SECTION—Meeting at the Engineers Club on December 12, at 7:30 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.

ST. LOUIS SECTION—Annual dinner meeting on December 9.

SAN FRANCISCO SECTION—Dinner meeting at the Engineers Club on December 19, at 5:30 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of Chattanooga Sub-Section on December 19, at 6:30 p.m.

Recent Activities

ALABAMA SECTION—*Tuscaloosa, October 12:* Joint session with the University of Alabama Student Chapter. Robert Morris, president of the Chapter, was in charge of the meeting and introduced the speakers. The main paper was presented by Donald A. du Plantier, associate professor of structural engineering at the University of Alabama, whose subject was "Some Aspects of the Design and Construction of the Tennessee River Bridge at Florence, Ala." G. P. Willoughby, project engineer for the Alabama State Highway Bridge Department, then gave a short talk on the triangulation and survey methods used in locating the bridge piers. Following this, a motion picture in color was presented by H. A. Davies, manager of the Virginia Bridge Company. A brief talk by J. H. Mayer, president of the Section, concluded the meeting.

ARIZONA SECTION—*Phoenix, October 26:* The Land Surveyors Conference, for which the Section acted as joint sponsor, was such a success that it was unanimously voted to make the conference an annual affair. There were 76 at the joint luncheon, and a larger number attended the technical sessions. One of the pieces of work accomplished was the adoption of a resolution urging the preservation of all land survey monuments as a matter of vital economic interest to the general public as well as to property owners.

BUFFALO SECTION—*September 22 and October 10:* The third annual golf outing and dinner took place at the Park Country Club at Williamsville on September 22. In the afternoon two foursomes took advantage of the course and the weather to show their prowess on the links, and excellent games were reported. Bridge and an interesting radio broadcast followed dinner. The principal speaker at the regular luncheon meeting, held on October 10, was Walter McCausland, supervisor of public relations for the International Railway of Buffalo. Mr. McCausland's topic, "Early Buffalo History," was of great interest to his audience.

CENTRAL ILLINOIS SECTION—*Champaign, October 19:* Following the regular monthly dinner, Jamison Vawter, member of the executive council of the Illinois Engineering Council reported on the activities of that group. The speaker of the evening was Benjamin F. Vandervoort, major in the Quartermasters' Corps of the U.S. Army and construction quartermaster at Chanute Field. Major Vandervoort discussed his engineering experiences.

CLEVELAND SECTION—*September 26:* The Section sponsored a joint meeting of the Founder Societies in Cleveland, the first gathering of its kind to be attempted in the city. The audience of 338 heard T. M. Girdler, chairman of the board of the Republic Steel Corporation, discuss the subject of the importance of the engineer to the advancement of science and industry. Mr. Girdler supplemented his subject with comments on the problems confronting the country at this time as a result of the war in Europe. Preceding his address, the chairmen of the various local groups of the Founder Societies gave brief talks. Donald B. Gilles, president of the American Institute of Mining and Metallurgical Engineers, was present and introduced Mr. Girdler to the assemblage.

COLORADO SECTION—*October 9:* The program arranged for this occasion concerned the army and navy, the speakers being Michael C. Grenata, captain, Corps of Engineers, U.S. Army, who is stationed at Fort Logan, and Captain Peters, of the U.S. Marine Corps. Captain Grenata discussed the "Duties and Organization of the Engineer Service in the Field," tracing the role of the Corps of Engineers in the development of the country. By means of charts and diagrams he showed the war-time work of the corps in a typical theater of operations. Captain Peters then presented motion pictures of the recent occupation of Shanghai, as viewed by the U.S. Marine Corps.

CONNECTICUT SECTION—*Hartford, October 26:* "The Activities of the Providence Engineer District with Special Reference to Flood Control" was the subject of discussion at this meeting, the speaker being Lt. Col. J. S. Bragdon, of the U.S. Engineer Office at Providence. Warren J. Scott, director of the Bureau of Sanitary Engineering of the Connecticut State Department of Health, presided at the meeting. The publicity chairman for the Section reports that fine local news releases were given this session.

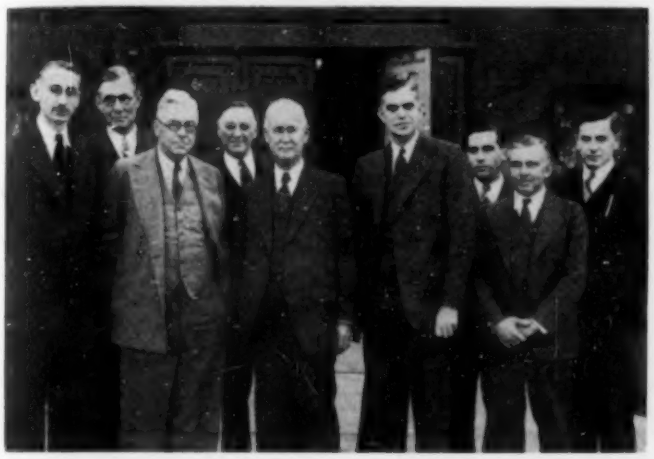
DAYTON SECTION—*October 16:* On this occasion C. E. Sherman, head of the civil engineering department at Ohio State University, gave a talk entitled "Message of the Eighteenth Century to the Twentieth."

DISTRICT OF COLUMBIA SECTION—*Washington, October 25:* The Junior Forum put on a splendid program for this occasion, and the

Section states that great credit is due T. Ritchie Edmonston, president of the Forum, and his committee for their competent presentation of a symposium entitled "The Young Engineer Looks Ahead." Members of the Forum participating in this symposium, in addition to Mr. Edmonston, were Richard E. Volland, James H. Carr, Jr., and W. O. Comello. A brief period of discussion was allowed after each eight-minute speech. Preceding the presentation of the symposium, Donald H. Sawyer, President of the Society, gave an introductory talk on Society affairs.

HAWAII SECTION—*Honolulu, September 25:* Following a dinner at the Pacific Club, Frederick Ohrt, chief engineer of the Board of Water Supply, City and County of Honolulu, was introduced as the speaker of the evening. Mr. Ohrt discussed in detail the water supply problems facing Honolulu, giving a technical analysis of the encroachment of salt water upon the artesian water supply of the city and outlining plans for conservation of the supply.

ILLINOIS SECTION—*October 20:* Several social events in honor of President Sawyer, who was guest of the Section, were enjoyed on October 20th. In the morning he spoke to about 200 students at the Armour Institute of Technology, where he was photographed with some of the Student Chapter members and had luncheon with



ARMOUR INSTITUTE FACULTY AND STUDENT CHAPTER OFFICERS WELCOME PRESIDENT SAWYER TO THE INSTITUTE

the faculty. In the afternoon he gave a talk to the students at Northwestern University, where he was the guest of the Student Chapter. That evening Colonel Sawyer was guest of honor at a dinner meeting held by the Section at the Chicago Engineers' Club. The list of guests included James L. Ferebee, Vice-President of the Society, and W. W. DeBerard, Director. Both spoke, as did L. D. Gayton, president of the Section. Colonel Sawyer gave the address of the evening, in which he discussed the Society and its problems.

INDIANA SECTION—*Indianapolis, October 20:* Following a business meeting, there was a talk on the sanitary problems of Chicago. This was given by Langdon Pearse, sanitary engineer for the Sanitary District of Chicago, who outlined the history of conditions since his association with the District, which began in 1906.

ITHACA SECTION—*October 19:* The following officers were elected at this, the annual, meeting: Ransome T. Lewis, president; Carl Crandall and Howard T. Ware, vice-presidents; and John E. Perry, secretary-treasurer. The technical program consisted of a talk by Lyman P. Wilson, professor of law at Cornell University, whose subject was "The Lawyer Looks at Language."

KANSAS CITY (MO.) SECTION—*October 19 and 30:* The Juniors in the Section acted as host to the Section at its first meeting of the fall, which took place on the 19th. The speakers were E. R. Downs, whose subject was "Soft Tunneling Methods as Used in Sewer Tunnel at Memphis, Tenn.," and Robert L. Rupley, who presented a paper on "Fire Protection for Oil Containers." Visitors at this session included student delegations from the Missouri School of Mines, the University of Kansas, and Kansas State College as well as faculty members of these schools. F. M. Cortelyou, Jr., was in charge of the program. A special dinner meeting was held on the 30th in order that the members might meet with the Society's Committee on Professional Objectives and discuss matters of interest to the Section in particular and the Society as a whole. E. R. Needles, chairman of the committee, introduced the members of the committee to the Section, and gave a résumé of the activities of his committee since its formation. He was followed by Field Secretary Jessup, who discussed the details of the committee's work. Other members of the committee and of the Section then engaged in an informal discussion of the problem of increasing the membership of the Society.

KANSAS STATE SECTION—*Topeka, October 27:* Several committee reports were presented at this session. The technical program consisted of a talk on the subject, "Existing Bridges in the Kansas State Highway System." This was given by F. W. Epps, bridge maintenance engineer for the Kansas State Highway Commission.

LEHIGH VALLEY SECTION—*Bethlehem, Pa., October 2:* An illustrated lecture on "The Operation and Maintenance of Airplanes in Transportation" was the feature of this occasion, the speaker being Ralph S. Damon, vice-president of American Airlines, Inc., in charge of maintenance and operation. The meeting was preceded by a dinner, at which the officers and a few invited guests had an opportunity to meet Mr. Damon and other representatives of the American Airlines.

LOS ANGELES SECTION—*October 11:* The program, which was prepared by the sanitary engineering group of the Los Angeles Section and the Metropolitan Water District of Southern California, consisted of papers by J. M. Montgomery and R. B. Diemer. Mr. Montgomery discussed the "Softening and Filtration of the Colorado River Water by the Metropolitan Water District," while Mr. Diemer's subject was "Distribution of the Treated Colorado River Water to the District Cities."

MARYLAND SECTION—*Baltimore, October 18:* Following a business session, an interesting sound motion picture depicting the history of baseball was shown. This film, which showed technical aspects of the game, was enjoyed by all. *Junior Association, Baltimore:* At the first meeting of the fall, which was held early in October, additional organizational matters were discussed. The group then heard a lecture on "Highway Safety and Related Research." This was given by J. T. Thompson, professor of civil engineering at Johns Hopkins University. An enthusiastic general discussion followed Professor Thompson's talk.

MICHIGAN SECTION—*Detroit, October 19:* The annual election of officers, held at this time, resulted as follows: Leroy C. Smith, president; E. L. Eriksen, first vice-president; A. B. Morrill, second vice-president; and George E. Hubbell, secretary-treasurer. The list of distinguished guests included President Sawyer, Past-President Riggs, Director Ayres, and Alex Dow, Honorary Member of the Society. Dr. Riggs introduced Colonel Sawyer, who gave a stimulating talk on Society activities, discussing particularly the proper approach to increasing the Society membership. Mr. Dow then delighted the gathering with his reminiscences on engineering and other subjects.

METROPOLITAN SECTION—*New York City, October 18:* On the 18th the subject of discussion was "Railway Transportation and the Functions, Opportunities, and Advantages for Civil Engineers in Railway Service." The speaker was Charles E. Smith, vice-president of the New York, New Haven and Hartford Railroad Company. An enthusiastic discussion followed Major Smith's talk. A special joint session with the American Society of Mechanical Engineers took place on the 31st to discuss "Problems of the Highway User in the United States." Those participating in this symposium were Frederick C. Horner, assistant to the chairman of the General Motors Corporation; William G. Grove, of the staff of the Connecticut State Highway Department; and Harold M. Lewis, chief engineer of the New York City Regional Plan Association. Thomas H. MacDonald, U.S. Commissioner of Public Roads, presided at the meeting.

NASHVILLE SECTION—*October 10:* A dinner at Vanderbilt University preceded the regular bimonthly technical meeting of the Section. The technical program consisted of a talk by J. W. Holman, architect, who discussed two new housing projects shortly to be constructed in the city.

NEW MEXICO SECTION—*Albuquerque, September 27:* This joint session with the University of New Mexico Student Chapter attracted an unusually large number of students and members. Following a business session, one of the members of the University of New Mexico staff spoke.

NORTHWESTERN SECTION—*St. Paul, November 6:* The speaker for this session—S. E. Hutton, of the U.S. Bureau of Reclamation—was unable to be present. However, parts of his paper on "Grand Coulee Dam and the Columbia Basin Reclamation Project" were presented by John W. Haw, director of agricultural development for the Northern Pacific Railway, who gave an account of the project.

OKLAHOMA SECTION—*Oklahoma City, October 14:* On this occasion entertainment was entirely in the hands of the Juniors, five of whom presented papers. These were Cline L. Mansur, of the engineering staff of Holway and Neuffer, whose subject was "Grand River Dam Surveys"; Douglas Bowers, of the Oklahoma State Highway Commission, who discussed "Highway Safety and the Engineer"; Henry McInerney, with the Reinhart and Donovan Company, of Oklahoma City, who discussed the relation of the contractor to the engineer; L. L. Laine, of the U.S. Geological Survey, who gave a talk on stream gaging in Oklahoma; and C. W. Sullivan, of the Oklahoma City engineering department, whose subject was "Needs and Means of Publicity for the Society."

OREGON SECTION—*Portland, October 10:* Glenn L. Parker, Director of the Society, discussed Society affairs, and R. B. Wright, president of the Section, reported on the Western Local Sections Conference held at the time of the Annual Convention. Later a collection of colored photographs was shown by Orrin Stanley.

PITTSBURGH SECTION—*October 14 and 19:* On the 14th a number of engineers visited the construction work of the Pennsylvania Turnpike Commission on a joint inspection trip arranged by the Section in cooperation with the civil section of the Engineers' Society of Western Pennsylvania. During most of the trip the group traveled over the new highway, stopping to view important structures including two of the tunnels. On the 19th there was a joint session of the same two professional groups. The paper of the evening—"Pittsburgh's Geological Setting and Engineering"—was delivered by C. R. Fettke, professor of geology and mineralogy at the Carnegie Institute of Technology, and T. B. Sturges, president of the Pennsylvania Drilling Company. This paper was illustrated by slides.

SACRAMENTO SECTION—*October 3, 10, 17, 24, and 31:* The list of speakers appearing at these five regular luncheon meetings included O. J. Porter, senior physical testing engineer for the California State Division of Highways; George W. Malone, consulting engineer-manager, The Industrial West, Inc.; Waldo A. Gillette, of the Monolith Portland Cement Company; G. H. P. Lichthardt, chemical engineer for the State Division of Highways; and Howard C. Wood, formerly designing engineer on the construction of the San Francisco–Oakland Bay Bridge. *Junior Forum, October 11 and 25:* A discussion on "Union Organizations for Engineers" was led by Arthur B. Sullivan and Vernon J. Hanses at the regular meeting of the Forum held on the 11th. At the same meeting Frederick Q. Teichert gave an illustrated talk on the North Fork Debris Dam. On the 25th members of the Forum and their guests visited the Sacramento Filtration Plant.

ST. LOUIS SECTION—*October 23:* A letter from the Chamber of Commerce regarding a noise-reduction campaign was read by the secretary, and a committee appointed to aid in this campaign. The speaker on the technical program was A. P. Greensfelder, who discussed his trip to Europe during the past summer, stressing activity in the construction field. As Mr. Greensfelder was the American delegate to the congresses of the International Chamber of Commerce at Copenhagen and of the Federation for Housing and Town Planning at Stockholm, he had many interesting incidents to relate.

SAN DIEGO SECTION—*October 21 and 22:* In lieu of their regular October meeting members of the San Diego Section took a field trip to Los Angeles on the 21st. The party visited the new Richfield Refinery at Long Beach, where they heard a lecture on the refining process and were shown through the plant, and the Griffith Observatory in Los Angeles. In the evening the group made a tour of the National Broadcasting Company studios in Hollywood, where they also witnessed a broadcast. The next day was devoted to inspection of the Union Depot in Los Angeles and the return trip to San Diego.

SAN FRANCISCO SECTION—*October 17:* A number of Student Chapter members were present at this session. The technical program consisted of a talk by Harold F. Gray on ancient and modern civilization. Mr. Gray is a sanitary and hydraulic engineer at Berkeley, Calif.

TACOMA SECTION—*October 10:* The speaker of the evening was Carl J. Nordstrom, consulting naval architect. Mr. Nordstrom gave a talk on the history of ship design and discussed modern trends in design, construction, and power. Ralph Finke was in charge of the program committee.

TOLEDO SECTION—*October 24:* A lecture on the subject of Ohio highways was the feature of this occasion, the speaker being D. F. Pancoast. Colonel Pancoast, who is manager of the Ohio Highway Planning Survey, supplemented his talk with motion pictures showing the field work of the Survey. An enthusiastic discussion followed his talk.

Student Chapter Notes

KANSAS STATE COLLEGE—*October 5:* The speaker at this session was Randall C. Hill, of the economics and sociology department of Kansas State College. Dr. Hill's talk proved especially interesting because of his use of slides and photographs, which he made in the European war zone during the past summer.

NEW YORK UNIVERSITY—*October 14:* On this occasion the Chapter was host to some members of the Cooper Union Student Chapter, the gathering being a reunion for those who attended the New York University surveying camp last summer. Prof. Douglas S. Trowbridge, faculty adviser, showed motion pictures of the camp as well as a colored film of some of the national parks that he visited recently.

PENNSYLVANIA STATE COLLEGE—*October 2 and 16:* The first of these meetings was a social gathering to which all students enrolled in the civil engineering department were invited. The aims of the Chapter were outlined at this time, and the membership of the students was solicited. At the second of these sessions O. E. McMullen, regional structural engineer in the Philadelphia office of the Portland Cement Association, addressed the Chapter on the subject of architectural concrete. Mr. McMullen used lantern slides to illustrate his talk.

UNIVERSITY OF CALIFORNIA—*October 16 and 18:* A big smoker initiated the year's activities. On this occasion over 200 students and members of the faculty heard Stub Allison, the University of California's varsity football coach, talk on the team's chances for the coming season. The first field trip of the semester took place on the 16th, when members of the Chapter visited the Alameda Naval Air Base now under construction. On the 18th there was a dinner meeting in Oakland. Walter N. Frickstad, city engineer of Oakland, was guest speaker and gave an enjoyable talk on his experiences as an engineer.

UNIVERSITY OF NORTH DAKOTA—*October 11 and 25:* The purpose of the meeting held on the 11th was to acquaint the new members of the Chapter with the aims and activities of the Society, the speaker being Alfred Boyd, faculty adviser. One of the Society's illustrated lectures was also enjoyed at this time. The speaker on the 25th was Frank Foley, head of the geology department.

UNIVERSITY OF TENNESSEE: At the first meeting of the fall semester the Chapter elected the following officers for the coming year: John E. Womack, president; Alfred Mouron, vice-president; Buford Winn, secretary; and George Fulghum, treasurer. The technical program consisted of a talk by A. T. Granger, professor of structures at the University of Tennessee, who gave an illustrated lecture on various types of bridges.

UNIVERSITY OF WASHINGTON—*October 10 and 24:* On the 10th C. C. Arnold, assistant engineer on the Lake Washington Pontoon Bridge, described this unique structure and its connecting highways. On the 24th Charles E. Andrew, consulting engineer, gave an interesting talk on suspension bridges.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for January

Two of this month's authors will be back again in the January issue with "follow-ups" on their respective topics. Charles E. Andrew, whose current article describes the floating bridge now being built on Lake Washington, has prepared a second paper dealing particularly with the unusual construction problems involved. And Ira D. S. Kelly, in his second paper, will tell of other modern developments in the use of timber, including structural application of plywood and laminated construction.

Two articles on seismic design are also on the schedule. "Effects of Foundation on Earthquake Motion" is the contribution of Prof. R. R. Martel, while Leon S. Moisseiff describes the provisions for seismic forces made in the design of the Golden Gate Bridge.

"Trends in Structural Design in the United States" will be discussed by O. H. Ammann. Progress in materials, design, testing, fabrication, and erection are all included in his treatment.

Of interest to highway engineers and to those engaged in city and district planning will be an article on roadside control through zoning, by L. Deming Tilton. Special emphasis is placed on activities along this line in California. Another highway paper, contributed by Lewis W. Hall, reports a series of experiments conducted in Arkansas on surface-course mixtures composed of fine aggregate and cut-back asphalt.

The field of sanitary engineering will be represented also in the January issue, with an article by Arthur Wardel Consoer on the new water supply project at Grand Rapids, Mich.

Backsights

A miscellany of events of interest to the Society, from the days of "Meetings at 20 o'clock" to the presidency of Onward Bates.

Membership of the Society in December 1889 reached a total of 545, of which 54, or 10 per cent, were Juniors. The entire area of the United States was represented, and there were members in 17 foreign countries.

Fifty-two years ago this month occurred the death of Brigadier General A. A. Humphreys, Hon. M. Am. Soc. C.E., co-author of the classic "Humphreys and Abbott Report" on the Mississippi River.

Forty years ago—in December 1899—the "present condition and prospective development" of wire-rope transmission of power was the subject of a paper before the Society, by A. C. Savage.

Ten years later—December 1909—interest at Society meetings was centered about discussions of "Water Supply for the Lock Canal at Panama" and "The New York Tunnel Extension of the Pennsylvania Railroad: The Cross-Town Tunnels." The membership list by that time had passed the 5,000 mark—a tenfold increase in 20 years.

"Lackawack Dam" Becomes "Merriman Dam"

In honor of the late Thaddeus Merriman, M. Am. Soc. C.E., the Board of Water Supply of the City of New York on October 31 designated the dam now under construction at Lackawack, N.Y., as the "Merriman Dam."

This dam is the first of those to be built under the Delaware Project, for an additional water supply for the city. The project was conceived by Mr. Merriman, sponsored by him throughout the attempted interstate negotiations, and finally defended in a masterly manner before the U.S. Supreme Court which, in its decision permitting the diversion, recognized the principle of equitable apportionment in place of the established principle of the English Common Law.

The resolution adopted by the Board of Water Supply is as follows:

"Whereas, Thaddeus Merriman, Consulting Engineer of the Board of Water Supply and its former Chief Engineer, now deceased, has through his genius and efforts made a signal contribution to the extension of the water supply of the City of New York; and

"Whereas, it is deemed fitting and proper that the memory of the accomplishments of Thaddeus Merriman be preserved for posterity;

"*Therefore be it resolved*, that the dam now being constructed by the Board of Water Supply at Lackawack, New York, be hereafter designated as the 'Merriman Dam.'"

Construction Data to Be Gathered by Census Bureau

Enumeration of some 200,000 building and construction contracting firms by the Bureau of the Census, under a schedule specially drawn up for the industry, is planned as part of a nation-wide Census of Business to begin January 2, 1940. Pertinent facts and figures will be gathered regarding buildings, and heavy and highway construction operations during 1939.

Representatives of engineering firms as well as builders were consulted on queries to be embraced in this schedule. As a result of these conferences, a section was included requesting builders and contractors to break down contracts or orders received under five subheadings: (1) new one- and two-family houses; (2) other new housekeeping residential buildings; (3) new buildings for industrial purposes; (4) new office and commercial structures, churches, public buildings, and so forth; and (5) repairs and alterations to buildings.

In addition, the schedule seeks information regarding work performed in 1939 and, under a separate heading, work performed during that year by location. Other queries cover material used, mechanical equipment installed, and merchandise sold; proprietor, firm members of family taking an active part in the business; the number of employees and total payroll; and a breakdown of a typical employment and payroll week.

The reports of the individual firms, it is stated, are strictly confidential. The Bureau is prohibited by law from permitting other governmental agencies to examine them.

Civil engineers as individuals will be enumerated under the Population, Occupations and Unemployment Census in April. The 1930 records reveal that civil engineers and surveyors had almost doubled during the prior decade. In 1920 there were 64,642 men and 18 women following the profession, while in 1930 the census counted 102,057 men and 29 women as civil engineers and surveyors.

Timber Bridge Design Contest Winners Announced

Results of the timber bridge design contest sponsored by the American Forest Products Industries, National Lumber Manufacturers Association, and Timber Engineering Company have just been announced. First prize of $500 went to William D. Smith of Portland, Ore., for a 70-ft Pony truss bridge with an 18-ft roadway, designed for an H-10 loading.

Winner of the second prize was E. H. McBroom, Assoc. M. Am. Soc. C.E. Another Associate Member of the Society, Harry Benkert, shared both the fourth prize and an honorary mention with E. George Stern.

In the student competition, the $100 first award was won by Daniel Burnett of Vancouver, B.C. Alfred Ackenheil, now a Junior in the Society, placed second, and Robert E. Tobin and Carl Reh, also Juniors, were among the 16 student contestants to receive $10 awards.

Brief Notes from Here and There

THE American Standards Association has announced approval as an "American Recommended Practice" of the 1938 revised Manual of Accident Prevention in Construction developed by the Associated General Contractors of America. This action, signifying the endorsement of a widely representative group of national organizations in the building field now active in A.S.A. work, "should do much to broaden the acceptance of the manual and thus to increase its effectiveness in preventing accidents." The manual is intended to serve as a guide to contractors in their daily accident-prevention problems on the job. Its 372 pages include recommendations for use of equipment, and sections on first aid, demolition of buildings, equipment upkeep, handling and storage of materials, scaffolding, camp sanitation and housing, loading and handling vehicles, and so forth. It can be purchased from the A.S.A., 29 West 39th Street, New York, N.Y., at $2.00 a copy.

* * * *

THE Highway Research Board of the Division of Engineering and Research, National Research Council, convenes in Washington, D.C., on Tuesday, December 5, for a four-day meeting. Eighteen sessions of the Board proper and of its various departments and committees are scheduled, the general topics including materials, roadside development, design, traffic, finance, and economics. The sessions are planned to provide considerable time for informal discussions.

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TENTH semi-annual meeting of the Eastern Photoelasticity Conference has been announced for December 9, at Cambridge, Mass., under the auspices of the Department of Mechanical Engineering, Massachusetts Institute of Technology. Programs and information can be secured from W. M. Murray, Room 1-321, Massachusetts Institute of Technology, Cambridge, Mass.

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AT THE twentieth annual meeting of the American Welding Society, held in Chicago from October 23 to 28, the following officers were elected for the coming year: president George T. Horton, M. Am. Soc. C.E.; first vice-president, T. C. Smith; second vice-president, Leon S. Moisseiff, M. Am. Soc. C.E.; secretary, M. M. Kelly; and treasurer, C. A. McCune. The list of directors-at-large, whose terms will expire in 1941, includes C. A. Adams, H. M. Priest, and P. G. Lang, Jr., Members Am. Soc. C.E. The term of H. C. Boardman, M. Am. Soc. C.E., as director-at-large will expire in 1942.

GEORGE T. HORTON

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THE Institute of Traffic Engineers has announced the election of the following new officers: president, Hawley S. Simpson, M. Am. Soc. C.E., of New York City; vice-president, D. Grant Mickle, Assoc. M. Am. Soc. C.E., of Lansing, Mich.; and secretary-treasurer, Harold F. Hammond, Assoc. M. Am. Soc. C.E., of New York City. The board of direction of the Institute consists of J. W. A. Bollong, John T. Gibala, Theodore M. Matson, Roger L. Morrison, Walter L. Rosenwald, and Leslie J. Sorenson. Professor Morrison is a member of the Society. These elections took place at the tenth annual convention of the Institute, which was held in Atlantic City, N.J., October 14 to 17.

NEWS OF ENGINEERS

Personal Items About Society Members

L. E. GRINTER, director of civil engineering and dean of the graduate school of Armour Institute of Technology, was recently appointed vice-president in charge of the internal administration of the Institute.

FRED S. CRESSWELL has resigned as engineer for the PWA in Washington, D.C., to become promotional engineer for the Clay Sewer Pipe Association, Inc., of Pittsburgh, Pa. In this position he will direct promotion work for the association in Virginia, West Virginia, Maryland, and Washington, D.C.

LE VAN GRIFFIS, until recently on the teaching staff of the California Institute of Technology, has accepted a position as instructor at the Armour Institute of Technology.

ROBERT B. JEWELL is now employed as a field engineer for the Mason and Hanger Co., Inc., with headquarters at Everett, Pa. He was previously assistant engineer for the Port of New York Authority.

CARL S. ELL has been elected president of Northeastern University to succeed Frank P. Speare, whose resignation will take effect in June. Dr. Ell has been on the university staff since 1909 and is at present vice-president and dean.

O. V. DERR announces his resignation as general office engineer and valuation engineer for the Erie Railroad Company in order to establish his own engineering and construction firm, with offices at 122 East 42d Street, New York City.

W. J. STRIBLING has been called into active duty by the U.S. Naval Reserve and sent to Sitka, Alaska, as resident engineer in charge of naval air base construction. Until lately Lieutenant Stribling was resident engineer for Frank T. Miller, of Greensboro, N.C.

C. R. STRATTMAN was recently appointed division engineer for the New York Central Railroad System, with headquarters at Jackson, Mich. He was formerly roadmaster for the Michigan Central Railroad.

MERIT P. WHITE, previously research assistant for the California Institute of Technology, has accepted a position as assistant professor of civil engineering at the Armour Institute of Technology.

CHARLES W. BAUGHN is now employed as an engineering draftsman in the design department of the refining division of the Phillips Petroleum Company, at Bartlesville, Okla. He formerly held a similar position with Lee C. Moore and Company, of Tulsa, Okla.

ROBERT HOFFMANN, GEORGE B. GASCOIGNE, and GUSTAV J. REQUARDT were appointed by the city of Cleveland in September to act as the mayor's advisory committee to study and recommend reasonable sewer rates for the maintenance and operation of interceptors and sewage treatment plants in that city.

CHARLES M. MOWER, JR., recently accepted employment with the Buffalo (N.Y.) Sewer Authority in the capacity of senior civil engineering draftsman.

WILSON T. BALLARD, engineering consultant for the Baltimore County Metropolitan District, has been named chief engineer of the Maryland State Roads Commission.

EMILIO PITTARELLI, consulting civil engineer of New York City and engineer in charge of foundation design for the New York World's Fair, has been awarded the high decoration of "Commander of the Crown of Italy" in recognition of his work as engineer of construction of the Italian Pavilion at the World's Fair. The presentation of the cross was made by His Excellency Admiral Giuseppe Cantu on behalf of King Victor Emmanuel in the presence of the Consul General Gaetano Vecchiotti on November 15.

JOHN C. TRACY, professor of civil engineering emeritus of Yale University, was honored recently by the unveiling of a tablet in his name and the dedication of the principal building of the Yale Engineering Camp near East Lyme, Conn., to him. Professor Tracy, former head of the civil engineering department at Yale, was the first to urge the establishment of an engineering camp at that institution.

TED M. MOODY, formerly with the International Boundary Commission, has been named administrative aide in the public works department of Dallas, Tex. He is the third member of the Society to be on the staff of the city administration there, the other two being JAMES W. ASTON, city manager, and E. A. BAUGH, director of public works.

F. M. Rexach is now field engineer for the WPA at Rio Piedras, Puerto Rico. He was formerly assistant resident engineer inspector for the PWA at Weehawken, N.J.

Ray L. Allin, until lately hydraulic engineer for the Hetch Hetchy Project at San Francisco, Calif., has been retained by the Marin Municipal Water District to arrange plans for the enlargement of Alpine Dam.

Earl F. Church, previously associate professor of photogrammetry at Syracuse University, is now professor of photogrammetry.

Arthur R. Ross, associate to the president of the St. Louis (Mo.) Board of Public Service, was recently appointed superintendent of the rail deck of the Municipal Bridge at St. Louis. Mr. Ross served as general supervisor in the building of the new Municipal Bridges approaches.

F. O. Dufour, regional engineer for the PWA in New York, has been appointed PWA project engineer in charge of the Pennsylvania General State Authority program, with offices in New York City and Harrisburg, Pa.

Warren R. Roberts announces his retirement as head of the Roberts and Schaefer Company, Chicago engineering and contracting firm, after more than thirty-five years of service in this capacity. Colonel Roberts expects to make his home in Miami, Fla.

Uel Stephens has been appointed assistant regional director and regional engineer for the PWA in Texas (Region 5). Until recently he was assistant regional engineer, with headquarters at Fort Worth, Tex.

John W. Gordanier has resigned as assistant engineer in the Denver office of the U.S. Bureau of Reclamation to accept a position with the Civil Engineering Corps of the U.S. Navy, at San Francisco, Calif.

F. J. Von Zuben, formerly engineer examiner for the PWA, has returned to private practice as a consulting engineer, with offices at Austin, Tex.

John H. Hande has been promoted from the position of accounting engineer for the Baltimore and Ohio Railroad to that of auditor of capital expenditures. He is located in Baltimore.

Frank R. Burnette has accepted the position of construction superintendent for the Carnegie-Illinois Steel Corporation at Pittsburgh, Pa. Until recently he was assistant chief engineer for the American Steel and Wire Company, at Cleveland, Ohio.

Frank S. Gilmore, staff member of the Asphalt Institute, is now district engineer in charge of the Institute's territory in District VII, which has its headquarters in Kansas City, Mo.

Robert B. Rhode is now a draftsman in the bridge department of the Northern Pacific Railway, with headquarters at St. Paul, Minn.

D. W. Cole, civil engineer for the Phoenix Engineering Corporation, New York City, is retiring for the time being and taking up residence in his old home at 408 Washington Avenue, Marietta, Ga. Mr. Cole began his engineering career in 1884.

George E. Hamlin has resigned as deputy commissioner for maintenance, Connecticut State Highway Department, because of poor health. Mr. Hamlin began his work with the Connecticut State Highway Department in 1909.

Ezra B. Whitman, consulting engineer and chairman of the Maryland State Highway Commission, has been made a member of the executive committee of the Maryland Traffic Safety Council.

George E. Linton, assistant engineer in the U.S. Engineer Office, has been transferred from Auburn, Calif., to the district office at Portland, Ore., to work on the design of the Willamette Valley project.

DECEASED

Erick Boine Erickson (Assoc. M. '38) assistant civil engineer in the Construction Division of the U.S. War Department, Washington, D.C., died recently at the age of 33. From 1925 to 1928 Mr. Erickson was rodman, instrumentman, and party chief with D. B. Metcalf, of Hartsdale, N.Y., and from 1930 to 1934 was instrumentman and assistant engineer for the Westchester County Sanitary Sewer Commission. Later he was with both the CWA and the Resettlement Administration before joining the staff of the War Department.

Karl Emil Erthal (Assoc. M. '38) associate engineer with Whitman, Requardt and Smith, of Baltimore, Md., died on September 26, 1939, at the age of 35. Mr. Erthal's entrance into the engineering field was deferred by an extended illness, the effects of which were with him the rest of his life. In 1933 he worked with the Maryland Water Resources Commission. In 1934 he became affiliated with Whitman, Requardt and Smith.

Gustave Joseph Fiebeger (M. '95) who served for twenty-six years as professor of civil and military engineering at the U.S. Military Academy at West Point, died in Washington, D.C., on October 18, 1939. He was 81. Upon his graduation from West Point in 1879, he was commissioned a second lieutenant of engineers. Later he was promoted through the various ranks, becoming a colonel in 1906. Colonel Fiebeger's service at the U.S. Military Academy began in 1896 and continued until his retirement in 1922. He was the author of several textbooks on military engineering and received the Distinguished Service Medal for his teaching services.

Thomas Alvin Gilkey (M. '15) president of the Thomas A. Gilkey Company, New Castle, Pa., died there on October 16, 1939. He was 78. Mr. Gilkey's early career was spent with the Pittsburgh Bridge Company, the American Bridge Company, and the Pennsylvania Engineering Works. In 1908 he established his consulting practice in New Castle and, in the same year, became engineer for Lawrence County, Pennsylvania, continuing in these capacities until his death.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Charles Edwin Grafton (M. '96) retired civil engineer of San Diego, Calif., died recently at the age of 85. Mr. Grafton's early career was spent in railroad work—with the Illinois Central Railroad, the Tacoma and Lake City Railroad, and the Union Pacific. Later he settled at New Cumberland, W.Va., where he was for a number of years county road engineer.

Mogens Ipsen (M. '36) city engineer of Rockford, Ill., died on October 19, 1939, at the age of 49. A native of Denmark, Mr. Ipsen spent the early years of his career there and in England. He came to this country in 1915 and worked for several firms in Iowa, and from 1920 to 1927 was with the Ferguson Construction Company at Rockford. In the latter year he established his own engineering and contracting practice there and, for the two years preceding his death, had also been city engineer.

William Dominick Larrabee (M. '04) retired civil engineer of West Hollywood, Calif., died recently at the age of 90. From 1890 to 1905 Mr. Larrabee held engineering positions with several West Coast electric railway companies. He then engaged in general engineering work and, from 1918 until his retirement in 1934, served, successively, as chief engineer for several companies—among them the Los Angeles and Pasadena Electric Railway Company, the Los Angeles Pacific Railroad Company, and the Southern California Edison Company.

Robert Emmett Link (M. '31) manager of distribution for the New York Steam Corporation, New York, N.Y., died at his home in Riverdale, N.Y., on September 2, 1939. Mr. Link, who was 47, joined the steam company in 1917 as a field engineer. Prior to that he had been with the Burling Engineering and Construction Company for about two years. During the war Mr. Link was engaged on the construction of Camp Meade and, later, served in the Coast Artillery Corps.

John Monks (Affiliate '98) New York City engineer, died on October 17, 1939, at the age of 76. Mr. Monks spent his career with the New York City contracting firm, John Monks and Son, which he

served as president for a number of years, succeeding his father in this position.

WALTER WOODBURY PATCH (M '08) civil engineer for the Los Angeles Flood Control District, Los Angeles, Calif., died in that city on August 9, 1939. He was 67. From 1896 to 1903 Mr. Patch was assistant engineer for the Metropolitan Water Works of Massachusetts. Later he was with the U.S. Bureau of Reclamation and the California State Highway Commission. For a number of years he maintained a consulting practice in Hollywood, giving it up in 1938 when he became connected with the Los Angeles Flood Control District.

HENRY BENJAMIN PATTEN (M. '88) retired civil engineer, died in Washington, D.C., on October 20, 1939, at the age of 84. Early in his career Mr. Patten was in the employ of the Union Pacific Railroad in Wyoming. From 1895 to 1899 he was city engineer of Cheyenne, Wyo., and from 1899 to 1914 chief clerk in charge of the U.S. Surveyor General's Office for Wyoming. In the latter year he became cadastral engineer in the General Land Office of the U.S. Department of the Interior, where he remained until his retirement in 1925.

EDWARD JOHN RUFF (Assoc. M. '16) engineer for the Marine Department of the American Bridge Company, Pittsburgh, Pa., died at his home in Sewickley, Pa., on October 20, 1939. He was 60. Mr. Ruff spent his entire career with the American Bridge Company, beginning as a draftsman in 1906. For a number of years he served as superintendent of the company's school of apprentices, in addition to his other work.

CHARLES SACRA (Assoc. M. '28) member of the contracting firm, Sacra and Watts, of Denver, Colo., died in that city on October 17, 1939. Mr. Sacra, who was 45, had been in Denver since 1924. During this period he was with the Colorado State Highway Department and the Colorado Builder's Supply Company, and in 1936 he organized his own firm. During the war he served overseas as first lieutenant in the Fifth Engineers.

WILLIAM FREDERIC STARKS (Assoc. M. '18) engineer of Glen Cove, N.Y., died at Mineola, N.Y., on November 1, 1939, from injuries suffered a few hours earlier in an automobile accident. Mr. Starks, who was 64, was county superintendent of highways for Nassau County, New York, from 1915 to 1922, and county engineer from 1922 until 1936. He retired in the latter year because of ill health.

SAMUEL STORROW (M. '04) retired civil engineer of Pasadena, Calif., died at his home there on October 22, 1939, at the age of 74. Early in his career Mr. Storrow engaged in a general engineering practice—first at Yakima, Wash., and later, at Colorado Springs, Colo. From 1899 until his retirement in 1936 he maintained a consulting practice in Los Angeles. During this period he was consultant to a number of Pacific Coast firms.

NATHAN DAVIS WHITMAN (Assoc. M. '06) chief engineer for the American Concrete and Steel Pipe Company, Los Angeles, Calif., died in Pasadena, Calif., on September 9, 1939. Mr. Whitman, who was 31, had been affiliated with the American Concrete and Steel Pipe Company for the past twenty-five years. Prior to that he was in charge of constructing a sewage disposal system for the city of Jackson, Mich.

FRANCIS CLINTON SHENEHON (M. '02) consulting engineer of Minneapolis, Minn., died in that city on October 3, 1939, at the age of 77. From 1909 to 1917 Mr. Shenehon was dean of the college of engineering at the University of Minnesota. He retired from this position in the latter year in order to devote his time to his consulting practice. He was consultant to the Sanitary District of Chicago, the Byllesby Engineering Corporation, and many other organizations, and he advised on water power and flood control projects in a number of foreign countries.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From October 10 to November 9, 1939, Inclusive

ADDITIONS TO MEMBERSHIP

ACKENHEIL, ALFRED CURTIS, JR. (Jun. '39), 440 Newtonville Ave., Newtonville, Mass.

ANDERSON, LESLIE ALFRED (Jun. '39), Junior Hydr. Engr., U.S. Engrs., Vicksburg, Miss.

ARMENTROUT, MICHAEL KING (Jun. '39), Civ. Engr., R. M. Douglass (Res., 519 Halsey Ave., Forest Hills), Wilkinsburg, Pa.

ASHBAUGH, LEWIS EUGENE, JR. (Jun. '39), Senior Eng. Aid., Public Roads Administration, Room 256, New Custom House, Denver, Colo.

ATCHISON, JAMES EDWARD (Assoc. M. '39), 16603 West Park Ave., Cleveland, Ohio.

AUPINO, WILLIAM BRADFORD (Jun. '39), 8917 Miles Park Ave., Cleveland, Ohio.

BAINTER, ROBERT GOODLIVE (Jun. '39), Gen. Plant Insp., State Dept. of Highways, Bureau of Tests, 155 West Woodruff Ave. (Res., 23 University Pl.), Columbus, Ohio.

BALDWIN, JOHN RAMSEY (Jun. '39), Chainman, N. P. Ry. (Res., 427 West Pine St.), Missoula, Mont.

BENWAY, WENDELL HAYDEN (Jun. '39), With New England Power Assoc., 441 Stuart St., Boston, Mass.

BERRY, ROY NEIL (Assoc. M. '39), Structural Engr., Dept. of Public Works, Puget Sound Navy Yard, Bremerton (Res., 2575 Tenth Ave., West, Seattle), Wash.

BOONE, MONTELLE NELSON (Jun. '39), Grafton, N.Dak.

BOTTOMS, ROBERT GALE (June. '39), Care, Survey Section, U.S. Engr. Office, Broadway and 3d, Little Rock, Ark.

BROWN, DONALD RAYMOND (Jun. '39), Deputy County Surveyor, Sonoma County, Court House, Santa Rosa (Res., 304 Powell St., Healdsburg), Calif.

BURKE, ROBERT WAYLAND (Jun. '39), Subway Rodman, City of Chicago, 20 Wacker Drive (Res., 5025 West Huron St.), Chicago, Ill.

CALVERT, WILLIAM NELSON, JR. (Assoc. M. '39), Associate Highway Engr., TVA, Pound Bldg. (Res., 721 Mississippi Ave.), Chattanooga, Tenn.

CHAPPELL, CARL JAMES (Jun. '39), Junior Hydr. Engr., U.S. Geological Survey, 6 Post Office Bldg., Fort Smith, Ark.

CLARK, GERALD DALE (Jun. '39), Eng. Aid, Army Engrs., 628 Pittock Blk. (Res., 2281 North West Everett), Portland, Ore.

COLVIN, WILLARD LEROY (Jun. '39), With Eng. Dept., Town of Bloomfield, Municipal Bldg. (Res., 5 Park St.), Bloomfield, N.J.

TOTAL MEMBERSHIP AS OF NOVEMBER 9, 1939	
Members	5,582
Associate Members	6,281
Corporate Members	11,863
Honorary Members	32
Juniors	3,849
Affiliates	73
Fellows	1
Total	15,818

FARNSWORTH, GEORGE LESTER, JR. (Jun. '39), San. Engr., Champaign-Urbana Health Dist., 307 South Wright, Champaign (Res., 230 Christie St., Ottawa), Ill.

FARROW, WILLIAM HENRY (Jun. '39), Junior Engr., U.S. Engrs., Govt. Moorings, 8010 North West St. Helens Rd. (Res., Parkway Manor), Portland, Ore.

FINK, GEORGE ROBERT (Assoc. M. '39), Instr., Coll. of Eng., Univ. of Illinois, 310 Transportation Bldg. (Res., 806 Main St.), Urbana, Ill.

FOOTE, EDWARD WATT (Jun. '39), With Central New York Power Corporation, 258 Genesee St. (Res., 2614 Sunset Ave.), Utica, N.Y.

FRYE, DONALD EDWARD (Jun. '39), Eng. Dept. Univ. of Omaha, Omaha, Nebr.

GATES, CLARK HARRISON (Jun. '39), 3 West St., Montpelier, Vt.

GILLELAND, JACK EMELIUS (Jun. '39), Care, Univ. of Tennessee, Knoxville, Tenn.

GLADFELTER, WILLIAM EDWIN (Jun. '39), 1323 Fifteenth St., Detroit, Mich.

GREEN, LLOYD FRANK (Jun. '39), Research Fellow, Fritz Eng. Laboratory, Lehigh Univ. (Res., 6 East 4th St.), Bethlehem, Pa.

GREER, DAVID MCKAY (Jun. '39), Asst. Engr., U.S. Engr. Office, Gay Bldg., Little Rock, Ark.

GREGG, LOWELL EDWARD (Jun. '39), Graduate Research Asst., Joint Highway Research Project, Purdue Univ., West Lafayette, Ind.

HABANS, ROBERT NAGLE (Jun. '39), Civ. Engr., Littrell Contr. Co., 617 Carondelet Bldg. (Res., 2817 Grand Route St. John), New Orleans, La.

HAVELY, HENRY BENTON (Assoc. M. '39), Civ. Engr., Box 163, Morristown, Tenn.

Hook, Clark Theodore, Jr. (Jun. '39), 142 Third St., Neenah, Wis.

Hopkins, Matthew Henry (Jun. '39), Sales Engr., W. C. Caye & Co., Box 4508, Atlanta, Ga.

Horton, Philip Zell, Jr. (Jun. '39), Const. Supt., State Div. of Parks, Springfield (Res., 211 Fulton St., Peoria), Ill.

Hudson, Bob Young (Jun. '39), Eng. Aid. (Civ.), U.S. Waterways Experiment Station, Box 80 (Res., 1337 Chambers St.), Vicksburg, Miss.

Hunter, Hubert Shipley (Jun. '39), Junior Engr., U.S. Geological Survey, Box 1311, Tucson, Ariz.

Hutchins, Melvin Ralph (Jun. '39), Asst. Structural Draftsman, U.S. Engr. Office, 332 Post Office Bldg., Baltimore, Md.

Huth, William Frank (Jun. '39), Recorder, U.S. Geological Survey, 14 Post Office Annex, Urbana, Ill.

Ingersoll, Harold Barrett (M. '39), Asst. Civ. Engr., Flood Control Survey, SCS, U.S. Dept. of Agriculture, Wallace Bldg. (Res., 923 South Caldwell St.), Salisbury, N.C.

Johnson, David Randolph (Jun. '39), Junior Engr., U.S. Engr. Dept., Industrial Trust Bldg., Providence (Res., 15 King St., Pontiac), R.I.

Kershner, Philip Quillman (Jun. '39), Delta Sigma Phi, State College, Pa.

Kidby, Harold Alfred (Jun. '39), Junior Civ. Engr., U.S. Army Engrs., 202 Pittock Blk., Portland, Ore.

King, Edward (Jun. '39), 33 West 8th St., Reno, Nev.

Lang, Edmund Herman (Jun. '39), 2045 Reinman St., Pittsburgh, Pa.

Larson, Lawrence Alex (Jun. '39), With Larson Building Co., Ridge Rd., Ambridge, Pa.

Larson, Lorys Juel (Jun. '39), Basic School, Navy Yard, Philadelphia, Pa.

LaVallee, Emery Alphonse (Assoc. M. '39), Landscape Engr., San Francisco Housing Authority, 525 Market St. (Res., 1206 Thirty-Third Ave.), San Francisco, Calif.

Lear, James Howard (Jun. '39), University Club, Bethlehem, Pa.

Libutti, Armando (Jun. '39), Civ. Engr. Campanella Const. Co., Inc., 86 Weybosset (Res., 5 Tower St.), Providence, R.I.

Livingston, John Hall (Jun. '39), Rolla-Salem Route, Rolla, Mo.

Lowe, Keith Carson (Jun. '39), 1210 West Clark St., Urbana, Ill.

McAlary, Francis James (Jun. '39), Engr., Beaver Val. Water Co., 1425 Eighth Ave., Beaver Falls, Pa.

McCabe, John Anthony (Jun. '39), Junior Constr. Insp., State Dept. of Highways, 908 Wabash Bldg. (Res., 5518 Hays St.), Pittsburgh, Pa.

McComas, James Roland (M. '39), Asst. San. Engr., State Dept. of Health, 2411 North Charles St. (Res., 2727 Hugo Ave.), Baltimore, Md.

McConnell, James Alexander (Assoc. M. '39), Chf. Res. Engr. Insp., PWA, 427 A Broadway, Everett (Res., 54 Woodside Rd., Winchester), Mass.

McCullough, Lane Allen (Jun. '39), Rodman, C. M. St. P. & P. R. R., Milwaukee R. R. Station (Res., 1547 Avon), La Crosse, Wis.

McDonald, Alfred Turner (Assoc. M. '39), County Highway Engr., Fulton County, 501 Courthouse (Res., 4675 Powers Ferry Rd.), Atlanta, Ga.

Mansfield, Elbridge Potter (Jun. '39), Transitman, State Highway Dept., Montpelier (Res., 112 South Main St., Waterbury), Vt.

Marcello, Angelo Antonio (Jun. '39), Timekeeper, Callan Constr. Co., Inc., Bristol (Res., 34 Orlando Ave., Cranston), R.I.

Marron, Hugh Wallace (Jun. '39), Junior Constr. Insp., State Dept. of Highways, Irvona, Pa.

Martin, William Courtney (Jun. '39), Tapeman, C. & N. W. Ry., Broadway Annex, Green Bay, Wis.

Mason, John Aquilin, Jr. (Jun. '39), Engr., Stellhorn & Beightler, 297 South High St., Columbus, Ohio (Res., 10 Brookland Court, Charleston, W.Va.).

Maxson, Thomas Emerson (Assoc. M. '39), Office Engr., Dept. of Public Works, 119 Court House (Res., 1409 Agnes Pl.), Memphis, Tenn.

Milazzo, Giovito Joseph (Jun. '39), Draftsman (Senior), War Dept., Picatinny Arsenal (Res., 64 North Bergen St.), Dover, N.J.

Moore, William James (Jun. '39), Engr., National Park Service, 412 Merrick St., Clayton, N.Y.

Moses, Franklin Collings (Jun. '39), With Old Ben Coal Corporation, Mine 12 (Res., 203 Sylvester St.), Christopher, Ill.

Mundal, Torald (Assoc. M. '39), Senior Civ. Engr., TVA, Knoxville, Tenn.

Munson, Hilding Kenneth (Jun. '39), With City of Providence, City Hall (Res., 14 Delmar Ave.), Providence, R.I.

Natt, George John (Assoc. M. '39), Junior Hydr. Engr., Public Service Comm., State of New York, 80 Center St. (Res., 229 Naples Terrace), New York, N.Y.

Neubauer, Fred William (Jun. '39), Junior Engr., Illinois Northern Utilities Co., 421 West 1st St. (Res., 616 North Galena Ave.), Dixon, Ill.

Niles, Thomas McMaster (M. '39), Res. Engr. Representative, Greeley & Hansen, 427 City Hall, Buffalo (Res., 28 Lowell Rd., Kenmore), N.Y.

Noce, Daniel (M. '39), Maj., Corps of Engrs., U.S.A., U.S. Engr. Office, Box 97, Memphis, Tenn.

Noragon, James Swisher (Jun. '39), Estimator and Salesman, Delavan Metal and Roofing Co., Inc., 379 East Delavan Ave. (Res., 147 Blaine Ave.), Buffalo, N.Y.

Olsen, Gerner Aktander (Jun. '39), Instr., Civ. Eng., Rutgers Univ. (Res., 147 Hamilton St.), New Brunswick, N.J.

Palmer, John Bert (Jun. '39), Draftsman, Ceco Steel Products Corporation, 1926 South 52d Ave., Cicero (Res., 7839 Essex Ave., Chicago), Ill.

Pan, Chao Wen (Jun. '39), Jung Yen, Kwangsi, Hongkong, China.

Perlstein, Edward (Jun. '39), South Fallsburg, N.Y.

Peterson, Earl Lloyd (M. '39), Project Engr., Federal Works Agency, 1504 City Hall (Res., 726 Amherst St.), Buffalo, N.Y.

Peterson, Robert Paul (Jun. '39), Surveyman, U.S. Engrs. (Res., 215 Eighth Ave., South), Moorhead, Minn.

Polivka, Jaroslav (M. '39), Research Associate, Univ. of California, 207 Eng. Materials Laboratory, Univ. of California, Berkeley, Calif.

Pretious, Edward Sinclair (Assoc. M. '39), Instr., Civ. Eng., Univ. of British Columbia, Vancouver, B.C.

Ray, Richard Arthur (Jun. '39), 1107 Colusa Ave., Berkeley, Calif.

Reedy, William Wesley (Jun. '39), Eng. Aid, U.S. Bureau of Reclamation, Box 510, Weiser, Idaho.

Reh, Carl William (Jun. '39), Draftsman, Ramtite Co., 2563 West 18th St. (Res., 2231 Farragut Ave.), Chicago, Ill.

Reid, Keith Cameron (Jun. '39), Structural Engr., Guy N. Rothwell, 409 Damon Bldg., Honolulu, Hawaii.

Reilly, James Patrick (Jun. '39), 1338 Middlefield Rd., Palo Alto, Calif.

Richardson, James Arthur, Jr. (Jun. '39), Subway Rodman, Dept. of Subways and Traction, City of Chicago, 22 East Huron St. (Res., 2716 Hampton Court), Chicago, Ill.

Riman, Bernard B. (Jun. '39), Insp. Rodman, Cook County Highway Dept., 188 West Randolph St. (Res., 3716 West Polk St.), Chicago, Ill.

Roberts, Joseph McCall (Jun. '39), Engr., Freeland-Roberts & Co., 3d National Bank Bldg. (Res., Granny White Park), Nashville, Tenn.

Samson, Samuel (Assoc. M. '39), City Engr., (Res., 906 North Halagueno St.), Carlsbad, N.Mex.

Schenk, Richard Frederick (Jun. '39), Testing Engr., Jersey Testing Laboratories, 154 Wright St. (Res., 424 Chancellor Ave.), Newark, N.J.

Shaw, Rollin Howard (Jun. '39), Senior Eng. Aid., Public Roads Administration, New Customs Bldg., Denver, Colo.

Shawen, Edgar Cornelius (Jun. '39), With Arlington County Eng. Dept., Courthouse (Res., 2506 Wilson Boulevard), Arlington, Va.

Sherrod, Archie Joseph (Jun. '39), Instrumentman, State Highway Dept., Camp R. M. Hubbard (Res., 404 West 13th St.), Austin, Tex.

Snyder, Charles William (Jun. '39), Insp., State Road Comm., R.F.D. Route 2, Charles Town, W.Va.

Sommerschield, Harold Ferdinand (Assoc. M. '39), Chf. Draftsman, Harza Eng. Co., 205 West Wacker Drive, Chicago, Ill.

Stanford, Gaston William, Jr. (Jun. '39), Engr., Dept. of Public Works, Box 1565, High Point, N.C.

Stepath, Myron Davis (Jun. '39), With New York Shipbuilding Corporation, Welding Div. (Res., 2983 Alabama Rd.), Camden, N.J.

Stewart, William Henry (Jun. '39), Junior Engr., Army Engrs., 209 Pittock Blk (Res., 2281 North West Everett St.), Portland, Ore.

Talcott, George Russell (Jun. '39), Sanitation Engr., Dept. of Health, Luray, Va.

Tapleshay, John Anthony (Jun. '39), San. Engr., Chicago Pump Co., 2336 Wolfram (Res., 2827 North Kildare Ave.), Chicago, Ill.

Thomson, Earl John Joseph (Assoc. M. '39), Care, Burns & McDonnell Eng. Co., 107 West Linwood Boulevard, Kansas City, Mo.

Thunder, Ivan d'Alton (Jun. '39), 1417 North Shore Ave., Chicago, Ill.

Trawicky, Bernard Looman (Jun. '39), 420 Third St., N.W., Minot, N.Dak.

Van Loo, Herman Willet (Jun. '39), 2204 East 6th St., Tucson, Ariz.

Vaughan, Harry Briggs, Jr. (M. '39), Maj., Corps of Engrs., U.S.A., Office, Chf. of Engrs., War Dept., Washington, D.C.

Wachter, William Mahler (Jun. '39), Research Asst., Iowa Inst. of Hydr. Research, Iowa City, Iowa.

Walker, George Amos (Jun. '39), Insp., Jersey Testing Laboratories, 154 Wright St., Newark (Res., 118 Essex Ave., Montclair), N.J.

Weber, Andrew (Jun. '39), Junior Engr., U.S. Engrs., 332 Post Office Bldg. (Res., 5906 Park Heights Ave.), Baltimore, Md.

Weber, Eugene William (Jun. '39), Asst. Res. Engr., U.S. Engr. Dept., Park Sq. Bldg., Boston, Mass. (Res., 145 Prospect St., Franklin, N.H.).

Membership Transfers

Amneus, Thomas Axel (Jun. '37; Assoc. M. '39), Chf. of Field Party, City of Oakland, City Hall (Res., 526 Fifty-Ninth St.), Oakland, Calif.

Anderson, John (Assoc. M. '37; M. '39), Prof., Civ. Eng., The Citadel, Military Coll. of South Carolina, Citadel Station, Charleston, S.C.

Bole, James Renwick (Jun. '28; Assoc. M. '39), Structural Engr., J. H. Davies, 803 Ocean Center Bldg. (Res., 3618 Walnut Ave.), Long Beach, Calif.

Crocker, Herbert Samuel (M. '01; Hon. M. '39), Cons. Engr., 1231 First National Bank Bldg., Denver, Colo.

Cushing, Paul Joseph (Jun. '36; Assoc. M. '39), Pres., Hydr. Dredging Co., Ltd., 1221 Central Bank Bldg., Oakland, Calif.

Cushman, Allerton Richardson (Jun. '30; Assoc. M. '39), Asst. Engr., Hydr. Dept., New England Power Service Co., 441 Stuart St., Boston, Mass.

DeFraites, Arthur Alexander (Jun. '28; Assoc. M. '39), Constr. Insp., Housing Authority of New Orleans (Res., 8408 Hickory St.), New Orleans, La.

DiGiacinto, Albert George (Jun. '33; Assoc. M. '39), Chf. Engr., Spencer & Ross, Inc., 2485 Scotten Ave., Detroit, Mich. (Res., 389 First St., North Hornell, N.Y.)

Ducharme, Jean Marc (Jun. '31; Assoc. M. '39), Res. Engr., Crandall Dry Dock Engrs., 238 Main St., Cambridge, Mass.

Ecker, John Beard (Jun. '28; Assoc. M. '39), Research Engr., Capital Transit Co., 36th and M Sts., N.W., Washington, D.C. (Res., 6315 Beachwood Drive, Chevy Chase, Md.).

Hale, John Symons (Jun. '37; Assoc. M. '39), Engr., The Harwood Beebe Co., Montgomery Bldg., Spartanburg, S.C.

Haswell, John Robert (Jun. '13; Assoc. M. '18; M. '39), Prof., Agri. Eng. Extension, Pennsylvania State Coll. (Res., The Orlando), State College, Pa.

Hazen, Richard (Jun. '34; Assoc. M. '39), Asst. Engr., Malcolm Pirnie, 25 West 43d St., New York (Res., Oliphant Ave., Dobbs Ferry), N.Y.

Hertz, Albert Leslie (Assoc. M. '31; M. '39), Project Engr., Johnstown Channel Impvt.,

U.S. Engr. Field Office, 5th Floor, Public Safety Bldg., Johnstown, Pa.

HICKS, JAMES ALLAN (Jun. '34; Assoc. M. '39), Junior Engr., U.S. Engr. Office, Custom House, Charleston, S.C.

IVERS, WILLIAM JOSEPH (Jun. '31; Assoc. M. '39), Asst. Engr., U. S. Engr. Office, Box 1234 (Res., 2606 Ridgecliff Ave.), Cincinnati, Ohio.

JACOBY, HENRY SYLVESTER (Affiliate '90; M. 22; Hon. M. '39), Prof., Emeritus, Bridge Eng., Cornell Univ.; 3000 Tilden St., N.W., Washington, D.C.

JAMESON, WILLIAM HOWE (Jun. '27; Assoc. M. '30; M. '39), Asst. Engr., Bethlehem Steel Co., Fabricated Steel Constr., Bethlehem, Pa.

KELLY, EDMONDE BERNARD (Jun. '35; Assoc. M. '39), 2d Lieut., Corps of Engrs., U.S.A., 615 Commerce Bldg., St. Paul, Minn.

KIEVIT, JAMES WESLEY (Jun. '29; Assoc. M. '39), Architectural Engr., Eng. Dept., Libbey Glass Co., Ash St. and W. & L. E. R. R. (Res., 2222 Portsmouth Ave.), Toledo, Ohio.

KRUMM, ERIC TAHLMAN (Jun. '34; Assoc. M. '39), San. Engr., Burgess & Niple, 568 East Broad St. (Res., 65 Meadow Park Rd., Bexley), Columbus, Ohio.

LOANE, EDWARD SICKEL (Jun. '29; Assoc. M. '39), Engr., Pennsylvania Water & Power Co., Lexington Bldg. (Res., 1708 Lakeside Ave.), Baltimore, Md.

LOVAN, CHARLES FELIX (Assoc. M. '37; M. '39), Engr. and Contr. (Hillyer & Lovan), Box 371, Jacksonville, Fla.

McDONALD, CHARLES CASTO (Jun. '31; Assoc. M. '39), Asst. Engr., U.S. Geological Survey, Ellenville, N.Y.

MADDEN, EDWARD PEUCH (Jun. '27; Assoc. M. '39), Structural Steel Detailer, Bethlehem Steel Co. (Res., 515 King St.), Pottstown, Pa.

MARTINEZ-PONTE, JOSÉ RAFAEL (Jun. '30; Assoc. M. '39), Topographic Engr., Compañia Consolidada de Petroleo, Edificio Principal (Res., Norte 14, No. 139), Caracas, Venezuela.

MASON, MARTIN ALEXANDER (Jun. '37; Assoc. M. '39), Asst. Hydr. Engr., National Hydr. Laboratory, National Bureau of Standards, Washington, D.C. (Res., 205 Raymond St., Chevy Chase, Md.)

MEHTA, RAMESH SUMANT (Jun. '37; Assoc. M. '39), Drainage Engr., P.W.D., Takhteswar, Bhavnagar, Kathiawad, India.

MOFFATT, JOHN GRAY (Jun. '31; Assoc. M. '39), Sales Engr., Truscon Steel Co., 2139 North Kerby Ave., Portland (Res., West Linn), Ore.

MOORE, BERNARD ALLEN (Jun. '29; Assoc. M. '39), Bridge Designer, A. T. & S. F. Ry., 80 East Jackson Boulevard, Chicago (Res., 116 East Minneola St., Hinsdale), Ill.

MOORE, RUSSELL BERNARD (Assoc. M. '28; M. '39), Cons. Engr. (Russell B. Moore Co.), 930 Indiana Pythian Bldg., Indianapolis, Ind.

MUNSON, GEORGE POINDEXTER, JR. (Jun. '38; Assoc. M. '39), Junior Res. Engr., State Highway Dept., Mount Vernon, Tex.

PRICE, SIDNEY LESTER (Jun. '30; Assoc. M. '39), Asst. Engr., National Park Service, Dept. of Interior, 930 Mulberry St. (Res., 1003 Thirty-Third St.), Des Moines, Iowa.

SHEPPARD, KENNETH ANTHONY (Jun. '26; Assoc. M. '39), With North-Eastern Constr. Co., 101 Park Ave., New York (Res., 133-33 Sanford Ave., Flushing), N.Y.

TAYLOR, THOMAS ULVAN (Affiliate '93; Assoc. M. '95; M. '01; Hon. M. '39), Emeritus Dean of Eng., Univ. of Texas, University Station, Austin, Tex.

WALBRIDGE, SMITH STARR (Jun. '37; Assoc. M. '39), Chf. Design Engr., W. Earle Andrews, 30 Rockefeller Plaza, New York (Res., 64-34 Ninety-Ninth St., Forest Hill), N.Y.

WITZIGMAN, FREDERICK SCOTT (Jun. '33; Assoc. M. '39), Asst. Engr., U.S. Engr. Office, War Dept., Hydr. Laboratory, Univ. of Minnesota, Minneapolis, Minn.

REINSTATEMENTS

BLOMGREN, ARTHUR CHARLES, Assoc. M., reinstated Oct. 25, 1939.

DRECHSLER, MEYER, Assoc. M., reinstated Nov. 1, 1939.

KEHOE, JAMES LUKE, Affiliate, reinstated Oct. 11, 1939.

KEMP, JOHN EDWARD, M., reinstated Oct. 11, 1939.

RICE, ERNEST GRAHAM, Assoc. M., reinstated Oct. 16, 1939.

RITCHIE, EDWARD WARREN, M., reinstated Nov. 6, 1939.

STRAUS, HAROLD SELIG, Jun., reinstated Oct. 30, 1939.

VAN DEUSEN, EDGAR ALLCHIN, M., reinstated Oct. 17, 1939.

RESIGNATIONS

MAIS, ERNEST NOEL, Assoc. M., resigned Oct. 20, 1939.

VAN DER VEEN, HERMAN, M., resigned Oct. 19, 1939.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

December 1, 1939 NUMBER 12

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

Grade	General Requirement	Age	Length of Active Practice	Responsible Charge of Work
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

AMIRIKIAN, ARSHAM (Assoc. M.), Washington, D.C. (Age 40) (Claims RCA 4.0 RCM 8.3) July 1928 to date with Bureau of Yards & Docks, Navy Dept., as Asst. and Associate Structural Engr., and (since July 1933) Designing Engr.

ANDREWS, DONALD COCHRANE, Jackson Heights, N.Y. (Age 37) (Claims RCA 2.8 RCM 6.0) 1925 to date with Turner Constr. Co., New York City as Rodman, Accountant, Job Engr., Asst. Supt. and Supt.

BENSON, CHARLES BEVERLEY (Assoc. M.), Pawling, N.Y. (Age 43) (Claims RCA 3.8 RCM 5.4) June 1934 to May 1939 Engr. (Statistical and Research), and May 1939 to date Prin. Val. Engr., New York Public Service Comm.

CLARK, LEO HENRY, Detroit, Mich. (Age 42) (Claims RCA 1.0 RCM 12.5) Sept. 1935 to date with FWA-PWA as Associate Engr., Engr., and Senior Engr., Grade P-5, Project Engrs. Office; previously Bridge Designer and Squad Boss, Michigan State Highway Dept., Lansing, Mich.

CONNOR, EDWARD COWEN, Dallas, Tex. (Age 56) (Claims RCA 9.5 RCM 20.0) 1921 to date Cons. Engr., Lone Star Gas Corporation.

DELSON, ISIDORE (Assoc. M.), New York City. (Age 63) (Claims RCA 6.8 RCM 24.6) Jan. 1939 to date Asst. to Deputy Commr., Dept. of Public Works, in charge of Bureau of Bridges; previously Engr., Dept. of Plant and Structures and Dept. of Public Works.

ELL, CARL STEPHENS (Assoc. M.), Boston, Mass. (Age 52) (Claims RC 22.2 D 15.3) Oct. 1914 to date with Northeastern Univ. as Director, Dept. of Civ. Eng., Asst. Dean, and (since Sept. 1917) Dean, School of Eng.; since Sept. 1925 also Vice-Pres., and since Sept. 1926 Dean of School of Business Administration.

GARDNER, WERNER CLARKE, Salisbury, Md. (Age 37) (Claims RCA 5.5 RCM 8.2) July 1936 to date Cons. Engr. for various municipalities; City Engr., Salisbury; previously Acting City Engr., Salisbury.

GENA, JOHN STIRLING (Assoc. M.), New Philadelphia, Ohio. (Age 51) (Claims RCA 10.9 RCM 9.1) July 1933 to date with Muskingum Watershed Conservancy Dist. as Prin. Asst. Engr., and (since March 1937) Asst. Chf. Engr.

HILL, BYRON ARTHUR (Assoc. M.), Palomar Mt., Calif. (Age 41) (Claims RC 11.5 D 3.5) June 1927 to June 1933 Bldg. Inspector and Structural Designer, and June 1936 to date Supt. of Constr., California Institute of Technology;

LET'S LOOK AT THE RECORDS

At first glance, these two 28-inch dredge liners *do* make you think of huge phonograph records. Actually, their stories are sweet music to engineers striving to tone down excessive losses from abrasion.

The steel liner, at left below, handled less than 1½ million cubic yards of material on the Ft. Peck Dam. Yet look at its condition!

On that same job, a liner of Ni-Hard, an extremely hard Nickel-chromium alloyed cast iron, shown at right below, handled 2⅓ million yards with only the wear shown by this photo. After inspection this Ni-Hard liner was reinstalled to deliver much more service.

Wherever wear is your problem, Nickel cast irons often offer the most economical answer. Special compositions containing Nickel — such as abrasion resistant Ni-Hard — will go a long way in solving costly replacement jobs. To obtain practical, helpful money-saving information please write us, explaining your specific materials requirements.

A—Steel liner, originally installed on the same 28-inch dredge, after only 1,470,500 yards. This steel liner was replaced by the Ni-Hard casting shown at right.

B—Cast by Thomas Foundries, Inc., Birmingham, this Ni-Hard Nickel iron liner handled 2,391,860 cubic yards of material and after inspection was put back in service to deliver still more yardage.

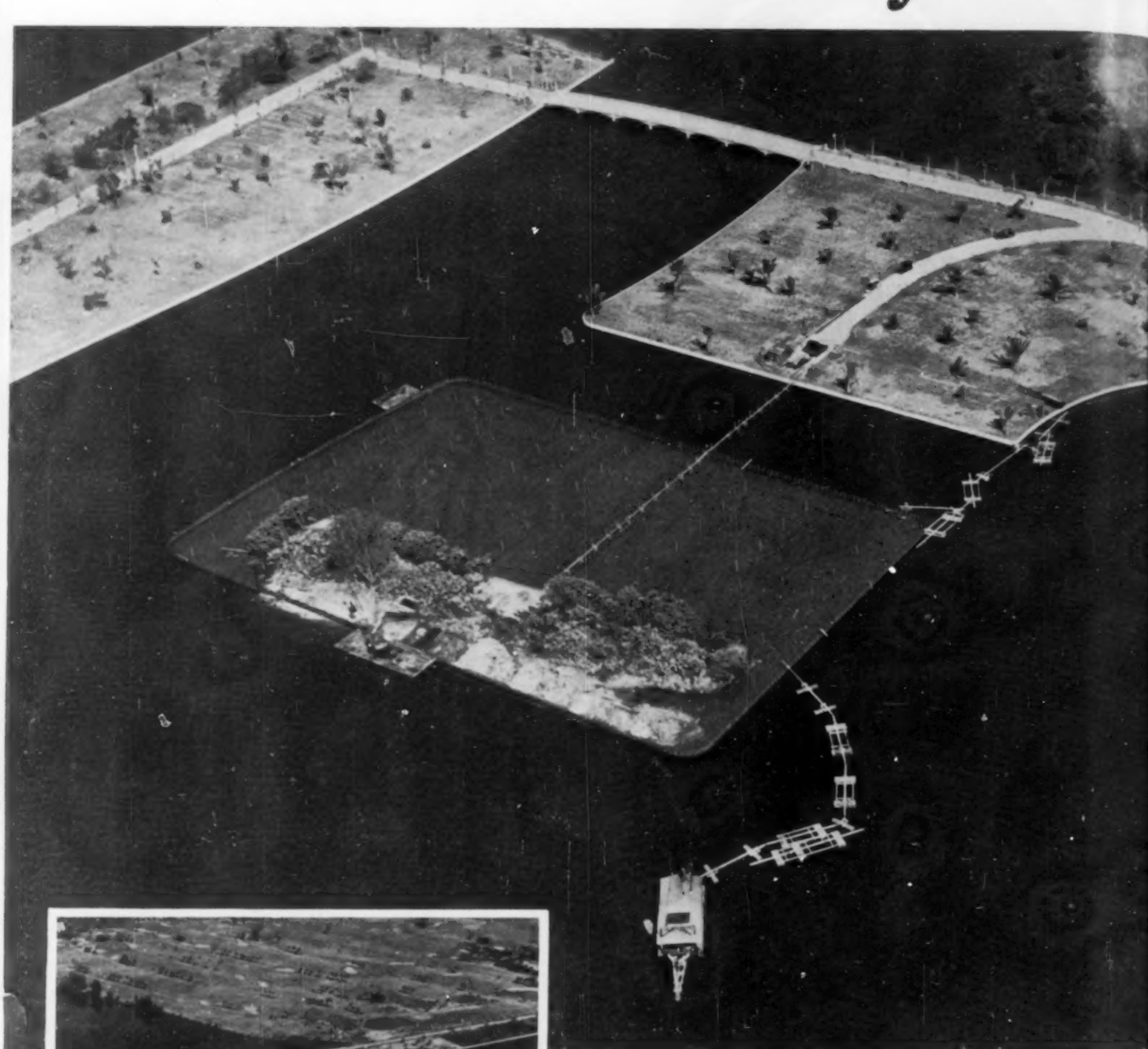
NI-HARD*

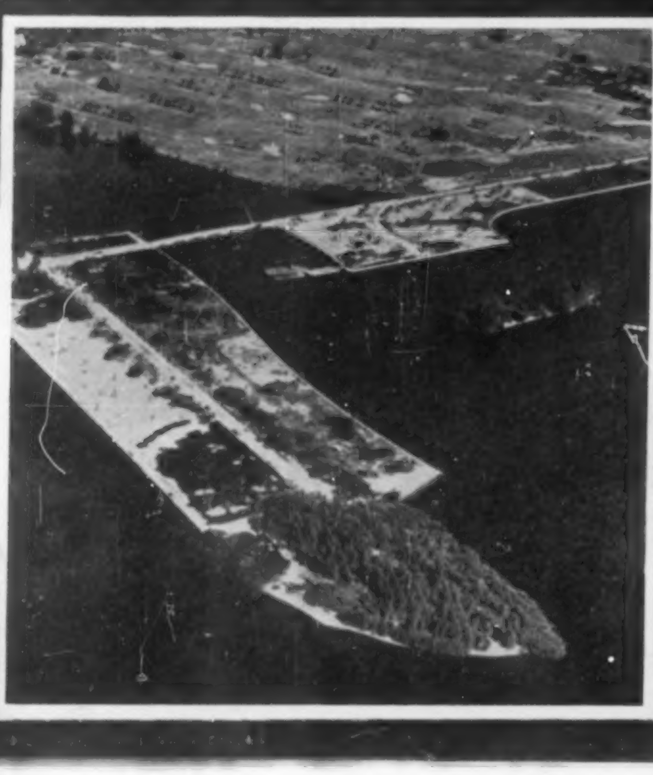
THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N.Y.

*Reg. U. S. Pat. Off. by the International Nickel Company, Canadian Patent No. 281,986

CIVIL ENGINEERING, December, 1939. Vol. 9, No. 12. Published monthly by the American Society of Civil Engineers. Publication office at 20th and Northampton Sts., Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 W. 39th St., New York, N. Y. Price 50c a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75c and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office at Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

Getting *Gold from th*





Engineer:—Geo. S. Brockway, West Palm Beach, Fla. *Contractor:*—M rphy Construction Company, West Palm Beach. *Owner:*—Bessemer Properties, Inc.

U N I T E D

m the Sea . . . the easy way

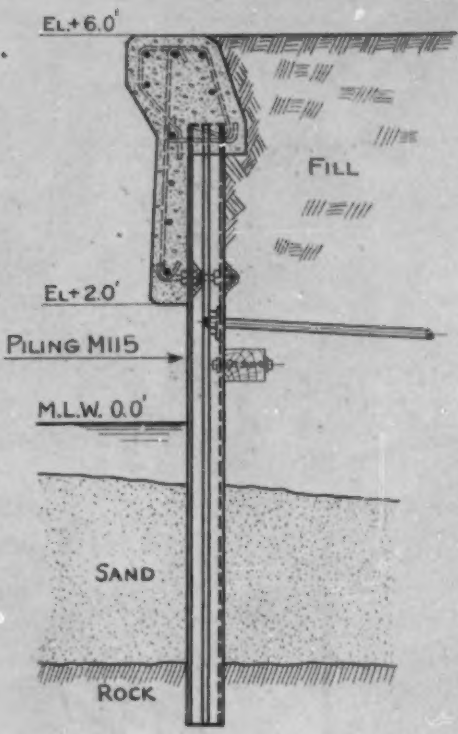
A simple bulkhead of U·S·S Steel Sheet Piling converts Lake Worth frontage into valuable residential property

HERE, within five minutes' drive of the business center of Palm Beach, Florida, a recently completed bulkhead of U·S·S Steel Sheet Piling not only adds to the attractiveness of the shore line but has converted two small islands into some 12 acres of highly desirable shore-front real estate.

The aerial photographs at left illustrate this profitable shore reclamation project. Large illustration shows the sheet piling bulkhead surrounding Clement Island, in place, ready for the sand fill from hydraulic dredge. Note the completed bulkhead along the shore proper. At lower left is illustrated the reclamation of what was formerly Lone Cabbage Island—the man-made land is clearly discernible. In all, some 750 tons of U·S·S Steel Sheet Piling, section M-115, were used in this construction—a total of 4200 lineal feet.

Reasons for the use of U·S·S Steel Sheet Piling here are the same as those which have led to its use in so many other Florida projects and elsewhere:—great strength, long life, low cost of installation, low expense for maintenance. Assembled in small units, it forms a wall that is water-tight, sand-tight and *continuous*—a sturdy barrier, strong to keep water in its place, free from marine borer attack and attractive in appearance as well.

Available in straight-web, arch-web and in the new "Z" sections, U·S·S Steel Sheet Piling is a rugged, lasting product. A *finished* product as shipped—ready to be handled and driven under the most difficult conditions of soil, water and surf. In breakwaters, bulkheads, seawalls, revetments, jetties, and groins, it provides ideal and economical protection against waves and tempest, against drifting and abrading sand. We welcome the opportunity of discussing its possibilities with you.



NOTE THE SIMPLICITY AND STURDINESS OF THIS CONSTRUCTION

The U·S·S Steel Sheet Piling in lengths from 9 to 27 ft. was driven through the sand bottom a minimum of one ft. into the coral rock. A 6" x 8" creosoted wale is located as shown. The anchor system consists of 1¼" tie-rods 18' long, set 9' 9" o.c., which are anchored to single U·S·S Sheet Piling sections also driven firmly into the rock bottom. A strongly reinforced concrete coping 4' deep, its 17½" top set at 6' above mean low water, caps the piling wall. View of the finished bulkhead on the page opposite shows how effectively it enhances the natural beauty of this location.

USS

U·S·S STEEL SHEET PILING

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Co., San Francisco, *Pacific Coast Distributors* · United States Steel Products Co., New York, *Export Distributors*

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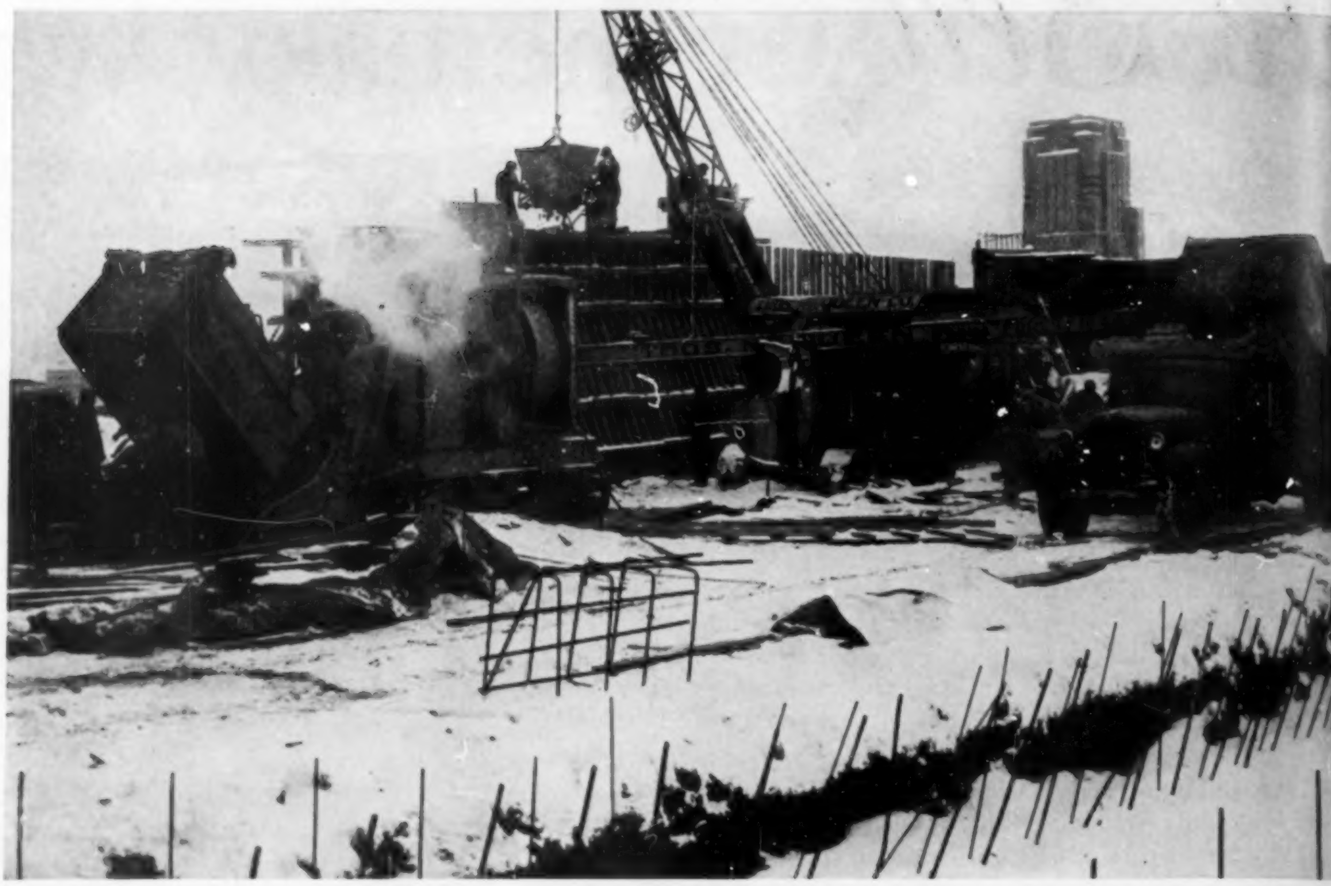

Chicago Cuts Winter Costs

'INCOR' USED FOR LARAMIE AVE. VIADUCT APPROACH

TAKEN in a driving snowstorm, picture (above) suggests cold-weather conditions under which the south approach of the new Laramie Avenue Viaduct was concreted last Winter. City of Chicago specified high early strength cement. Thomas McQueen Company, of Forest Park, Ill., Contractor, used 'Incor' 24-Hour Cement. Result: Service strength in one-fifth the usual time—with a corresponding saving in heat-protection costs.

It pays to remember that the quicker concrete hardens the less time and expense are required to provide costly heat-protection. 'Incor' 24-Hour Cement saves real money on cold-weather work because it gains strength faster and the concrete is safe from freezing sooner. Heat mixing water and aggregates; to avoid heat loss, protect the concrete promptly after placing; then, with 'Incor', provide heat-protection for 24 hours after concrete is placed. When temperatures are below 20°, provide protection for 48 to 72 hours. 'Incor'* saves, at very least, two days' heat-curing on each pour.

To fuel and labor savings, add reduced form costs and lower job overhead as well. Figure these savings on work now in progress; you'll be money ahead if you do. Write for copy of "Cold-Weather Concreting." Lone Star Cement Corporation, Room 2272, 342 Madison Avenue, New York.

*Reg. U. S. Pat. Off.

Sales Offices: ALBANY, BIRMINGHAM, BOSTON, CHICAGO, DALLAS, HOUSTON, INDIANAPOLIS, JACKSON, MISS.; KANSAS CITY, NEW ORLEANS, NEW YORK, NORFOLK, PHILADELPHIA, ST. LOUIS, WASHINGTON, D. C.

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CAGO,
ANSAS
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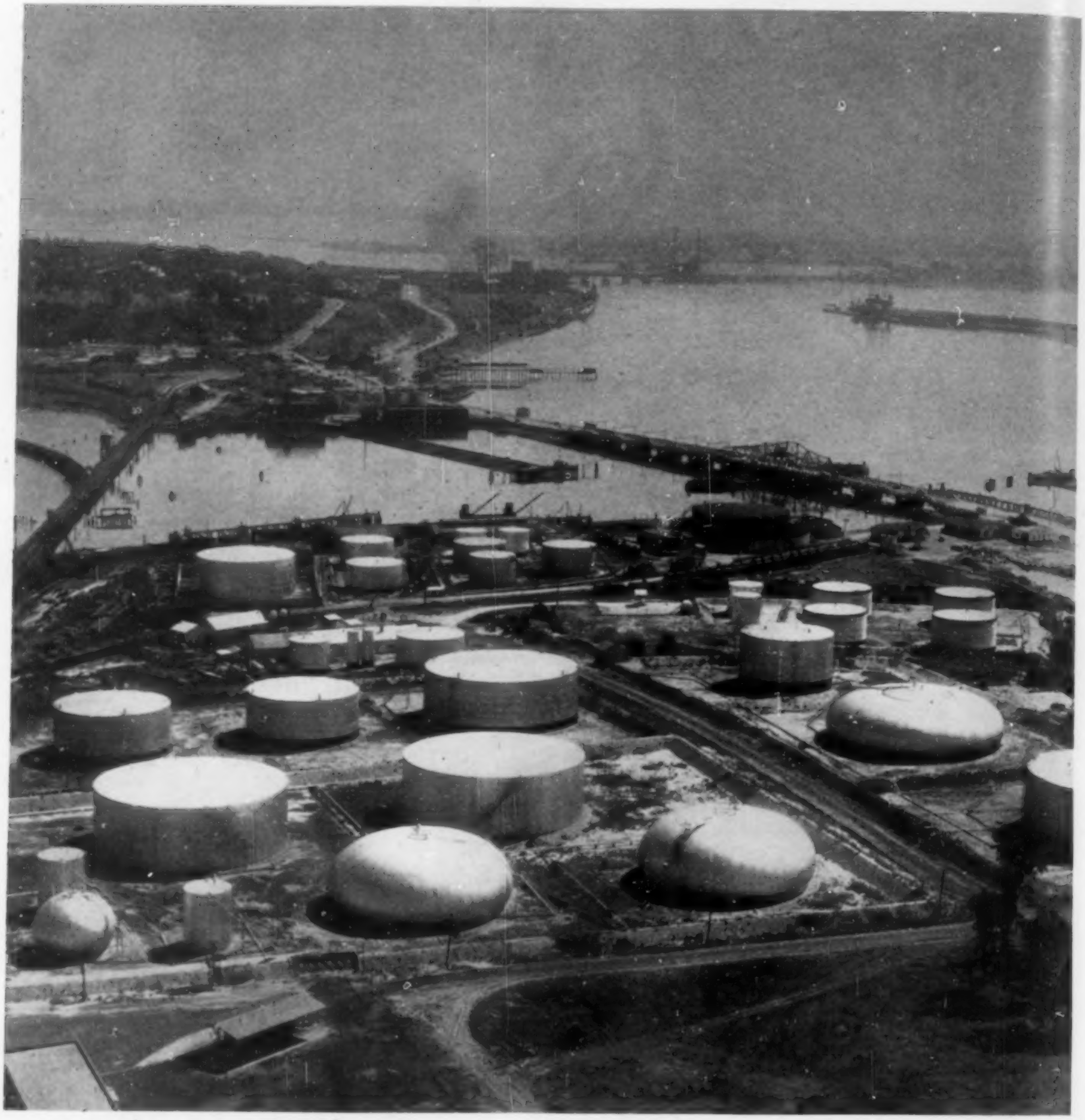
Pont du Gard

Ancient Aqueduct in Southern France. Built by the Romans About 18 A.D.



STEEL TANKS of Special Design for Economy

A few years ago, when people first started to fly extensively, tanks all looked pretty much the same. In a few short years, however, many installations of different types and shapes have blossomed out where there previously were only the common garden variety. Pleasing as many of these installations appear, they are designed primarily to provide more economical and efficient storage facilities under the particular conditions encountered.

The above view shows six oil storage terminals at the South Portland, Me., harbor. The four Hortonspheroids—one 6,000-bbl., two 50,000-bbl. and one 80,000-bbl. capacity—are used to store motor fuel gasoline under $1^1/_2$ to $2^1/_2$ lbs. per sq. in. pressure.

The present day air traveller also sees spherical tanks for storing volatile liquids and gases under pressure, tanks with pontoon, breather or balloon roofs, elevated tanks in modern motifs and many other special structures shaped from steel plates.

When designing storage facilities of any type, write our nearest office for estimates.

CHICAGO BRIDGE & IRON COMPANY

Chicago............2199 Old Colony Bldg.
Detroit............1541 LaFayette Bldg.
Cleveland............2263 Rockefeller Bldg.
New York.........3395—165 Broadway Bldg.
Boston.........1545 Consolidated Gas Bldg.
Philadelphia.......1652-1700 Walnut Street
Dallas..............1485 Liberty Bank Bldg.
Houston..................2919 Main Street
Tulsa......................1647 Hunt Bldg.
Birmingham............1596 N. 50th Street
San Francisco.............1084 Rialto Bldg.
Los Angeles............1456 Wm. Fox Bldg.

B-685

PLANTS in BIRMINGHAM, CHICAGO and GREENVILLE, PENNA.

Squared masonry for Rome...

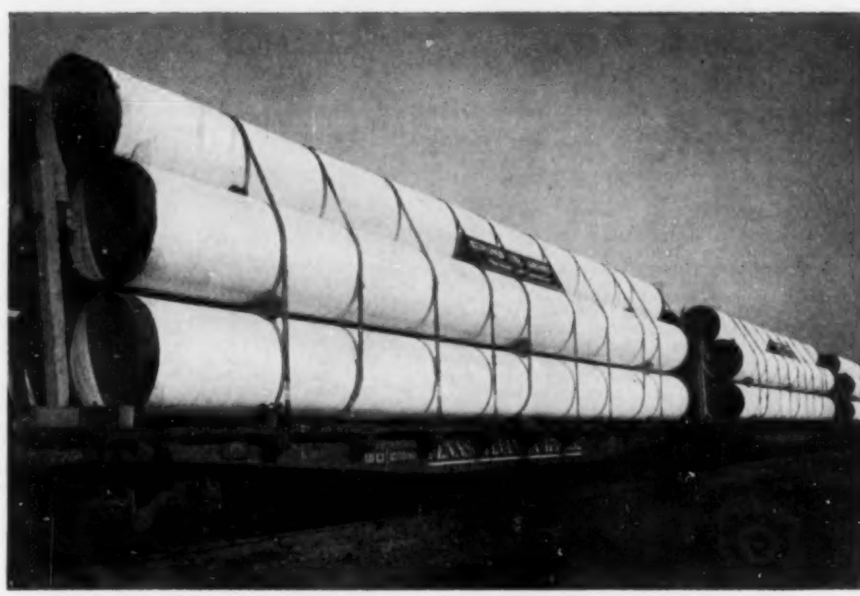
50 A.D.

The ruins of the Claudian Aqueduct finished in 50 A.D. are a monument to the engineering genius of Emperor Claudius. Of squared masonry construction, this 44-mile conduit carried spring water to the fountains and bath houses of ancient Rome.

Electric-welded pipe for Cleveland...

1939 A.D.

Part of a shipment of electric-welded pipe supplied by Bethlehem for the Brookpark Road water main in Cleveland, Ohio. Bethlehem has furnished steel materials for many of the country's outstanding water supply systems.



While ancient aqueducts took years to build, Bethlehem moves swiftly and smoothly as a manufacturer and supplier of electric-welded, spun-enamel-coated pipe. Both fabricating and steel-making divisions are closely-knit parts of the same company and function as a unit. As a result of this coordination, needless delays can be eliminated and contracts can be completed well within the specified time limits.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

in the interim Asst. Testing and Concrete Engr., Metropolitan Water Dist. of Southern California.

HODGES, THOMAS VICTOR, Harrisburg, Pa. (Age 58) (Claims RCA 8.1 RCM 19.4) Jan. 1931 to date Engr., Bureau of Waters, Commonwealth of Pennsylvania.

HORAN, FRANK WILLIAM, South Bend, Ind. (Age 48) (Claims RC 24.4 D 6.2) Sept. 1921 to date with Univ. of Notre Dame, Notre Dame, Ind., as Asst. Prof., Associate Prof., and (since Sept. 1934) Prof., of Civ. Eng.

HYLAND, RICHARD VINCENT, Long Island City, N.Y. (Age 44) (Claims RCM 10.7) March 1929 to date member of firm, Madigan-Hyland, Cons. Engrs.

LEAVEY, EDMOND HARRISON, Bronxville, N.Y. (Age 45) (Claims RCA 8.0 RCM 10.1) Sept. 1917 to date with Corps. of Engrs., U.S. Army, at present as Major.

MCCAIN, DEWEY MARVEN (Assoc. M.), State College, Miss. (Age 40) (Claims RCA 3.8 RCM 12.2) Sept. 1930 to date Prof. and Head of Dept. of Civ. Eng., Mississippi State Coll.

MATTHEWS, CHARLES WILLIAM (Assoc. M.), Charleston, W.Va. (Age 35) (Claims RCA 2.0 RCM 6.0) May 1938 to date Res. Planning Engr., Municipal Planning Comm.; previously Civ. Engr., New York Div. of State Planning; City Planner associated with Frederick J. Adams, Planning Consultant; Civ. Engr., New England Regional Planning Comm.

ROUNDS, WILL ARTHUR, Houston, Tex. (Age 37) (Claims RC 11.6 D 9.1) Feb. 1929 to date Engr., Continental Oil Co. of Delaware; since Aug. 1937 in charge of Texas and Louisiana divisions.

SHULER, TOM CRAWFORD (Assoc. M.), New Philadelphia, Ohio. (Age 48) (Claims RCA 8.9 RCM 9.4) July 1934 to date with Muskingum Watershed Conservancy Dist. as Asst. Engr., Constr. Engr., and (since July 1938) Maintenance Engr.

SMITH, THOMAS ROY, Friant, Calif. (Age 46) (Claims RCA 13.1 RCM 6.1) June–Nov. 1915 and March 1916 to date with U.S. Bureau of Reclamation as Surveyman, Inspector, Hydrographer, Asst. Engr., Associate Engr., and (since April 1936) Engr., acting as Office Engr. on investigations for Friant Div.

THIBODEAU, GEORGE FREDERICK (Assoc. M.), Wolfeboro, N.H. (Age 42) (Claims RC 16.4 D 3.0) May 1927 to date Pres., Hagan-Thibodeau Constr. Co.

THOMPSON, THORALF SANFORD (Assoc. M.), Brooklyn, N.Y. (Age 39) (Claims RCA 3.6 RCM 9.6) May 1937 to date Asst. Engr. Designer, Board of Water Supply, New York City; previously Superv. Engr. Designer, Parks Dept., New York City.

THOMSEN, JOHN WILLIAM, St. Louis, Mo. (Age 51) (Claims RCA 11.0 RCM 15.0) 1913 to date with Stupp Bros. Bridge & Iron Co. as Engr., Secy., and (since 1926) Vice-Pres.

TRIBBLE, JOHN FURMAN (Assoc. M.), Montgomery, Ala. (Age 39) (Claims RCA 4.4 RCM 8.5) May 1922 to Dec. 1928 and April 1932 to date with Alabama State Highway Dept., as Draftsman, Res. Engr., Location Engr., Inspector, Materials Engr., etc., and (since March 1939) Prin. Asst. Materials Engr. and Research Engr.

TRUE, WILLIAM HOWARD, Pottstown, Pa. (Age 40) (Claims RC 6.4 D 4.6) July 1939 to date Steel Detailer, Bethlehem Steel Co.; previously Structural Designer, Paist and Steward, Archts., Miami; Structural Detailer and Designer, Aetna Steel Co., Jacksonville, Fla.; Structural Designer and Industrial Investigator, Panama Canal Dept., Balboa Heights, Canal Zone.

WELLS-JONES, ARTHUR JOHN, Cape Town, South Africa. (Age 65) (Claims RCA 10.0 RCM 31.1) Feb. 1938 to date in private practice as Cons. Engr. and Contr.; previously with Cape Circle, Irrigation Dept., on design and survey; Res. Engr. in charge Marico Bosveld irrigation and canal system.

WILBERDING, MARION XAVIER, Washington, D.C. (Age 48) (Claims RCM 22.8) Oct. 1937 to date Pres., Wilberding Co., Inc., Cons. Engrs., and (since Dec. 1938) also of Wilberding & Palmer, Inc., Mobile, Ala.; since 1938 also Vice-Pres. and Gen. Mgr., Mountain State Water Co.; June 1917 to Oct. 1937 Mech. Engr., Vice-Pres., and Pres., Francis R. Weller, Cons. Engr., Washington, D.C.

APPLYING FOR ASSOCIATE MEMBER

BALDY, NEVILLE WILLIAM, Yarra Junction, Victoria, Australia. (Age 29) (Claims RCA 4.5 RCM 0.0) Feb. 1939 to date Engr. and Secy. to Shire of Upper Yarra; previously with State Rivers and Water Supply Comm., Melbourne, as Second Asst. on construction staff of Yarrawonga Weir, and Asst. Engr., Investigation and Design Div., Head Office.

BOON, LEONARD FRANCIS, Minneapolis, Minn. (Age 59) (Claims RC 21.2 D 1.7) Jan. 1921 to June 1924 Instructor in, and Sept. 1924 to date Asst. Prof. of, Civ. Eng., Univ. of Minnesota.

BREWER, WILL, Pittsburgh, Pa. (Age 32) (Claims RCA 2.2 RCM 0.0) June 1930 to Aug. 1931, July 1932 to March 1937, and May 1937 to date with U.S. Corps of Engrs. as Jun. Engr., and (since Oct. 1938) Asst. Engr.

CAPONE, RALPH GEORGE (Junior), Nutley, N.J. (Age 32) (Claims RCA 4.8 RCM 0.0) Nov. 1933 to date with U.S. Forest Service, CCC, as Foreman (Jun. Civ. Engr.), Project Supt., and (since April 1939) Jun. Administrative Asst.

CANTONO, WILLIAM PAUL (Junior), New York City. (Age 32) (Claims RCA 4.5 RCM 2.1) June 1937 to April 1938, and Jan. 1939 to date as Eng. Inspector, and (since June 1939) Asst. Engr., Board of Water Supply; in the interim and previously with WPA as Asst. Engr. Supervisor, Asst. Engr., and Asst. Superv. Engr.

CLINE, FREDERICK (Junior), Covina, Calif. (Age 32) (Claims RCA 4.3 RCM 0.4) Jan. 1938 to date with U.S. Engr. Office, Los Angeles, as Asst. Hydr. Engr. and (since June 1939) Associate Hydr. Engr.; previously Jun. Hydr. Engr., U.S. Bureau of Reclamation; Jun. Bridge Constr. Engr., California State Highway Dept.; Hydrographer, Los Angeles Dept. of Water and Power.

GERARDI, JASPER (Junior), Detroit, Mich. (Age 32) (Claims RCA 2.5 RCM 0.0) 1929 to date with Univ. of Detroit as Instructor and (since 1937) Asst. Prof. of Civ. Eng. Drawing.

GOLDMAN, PERRY JOSEPH (Junior), Philadelphia, Pa. (Age 31) (Claims RCA 3.8 RCM 7.0) Oct. 1926 to Feb. 1934 and Oct. 1935 to date with Golder Constr. Co., Inc. as Estimator, Chf. Estimator, Field Engr., Asst. Chf. Engr., and Engr.-in-Chg.; in the interim Chf. Engr., Builders, Inc., Engrs. and Contrs.

HALLVIK, CARL CLIFFORD (Junior), Boise, Idaho. (Age 32) (Claims RCA 2.0 RCM 0.7) July to Nov. 1932 and July 1933 to date with Idaho Bureau of Highways as Inspector, Transitman, Dist. Materials Engr., Res. Engr., Asst. Materials Engr., and (since March 1939) Materials Engr., also acting as State Materials Engr.

HANKS, LAWRENCE FILLER (Junior), Denver, Colo. (Age 32) (Claims RCA 4.2 RCM 0.0) March 1930 to date with U.S. Geological Survey, Water Resources, as Jun. Engr., and (since Oct. 1935) Asst. Engr.

HEYDT, FREDERICK GEORGE, New York City. (Age 37) (Claims RC 11.0 D 3.2) Dec. 1932 to date Pres., Heydt-Mugler Co., Inc., Engrs. and Contrs.

HICKS, EDGAR FLANOY, JR. (Junior), Washington, D.C. (Age 32) (Claims RCA 0.4 RCM 2.3) July 1930 to date with U.S. Coast & Geodetic Survey as Jun. Officer, Chf. of Party, Consultant to Dist. Engr., U.S. Army, and (since April 1939) on hydrographic surveys and triangulation in Alaska.

HUBLER, JOHN WILLIAM, West Lafayette, Ind. (Age 30) (Claims RC 1.7) Feb. 1936 to date with Agricultural Eng. Dept., Purdue Univ. as Asst. Instructor and (since Sept. 1937) Instructor; previously with Indiana State Highway Comm. on location surveys.

HUMMEL, RICHARD JACOB, Atlanta, Ga. (Age 39) (Claims RCA 3.3 RCM 2.0) March 1939 to date Asst. Engr., Grade P-2, PWA; previously with Florida State Road Dept., Tallahassee, Fla., as Instrumentman, Project Engr., Inspector, and Asst. Maintenance Engr.

INABA, MINORU, New York City. (Age 32) (Claims RCA 4.1 RCM 0.0) Sept. 1937 to date Structural Steel Designer with Parsons, Klapp, Brinckerhoff & Douglas; previously Structural Steel Draftsman with Bethlehem Steel Co., Shapiro Associates, and Weatherly Steel Co.

KASSNER, JOHN JACOB, New York City. (Age 30) (Claims RCA 4.5 RCM 0.0) Aug. 1938 to date Topographical Draftsman, Grade 4, President of Borough of Manhattan; previously Eng. Asst., Dept. of Docks, New York City; Draftsman, Dept. of Parks.

KERNAN, FRANCIS FREDERICK, University City, Mo. (Age 37) (Claims RCA 14.0 RCM 0.0) April 1923 to date with City Engr.'s Office as Draftsman, Chf. Draftsman, and (since Jan. 1927) Office Engr.

KOERNER, FRITZ A., Brooklyn, N.Y. (Age 34) (Claims RCA 3.1 RCM 7.8) June 1938 to date Squad Chf., FWA, PWA, responsible for engineers and personnel; previously Engr., FEA of PW.

LOUCKS, DONALD ALLEN, Long Beach, Calif. (Age 32) (Claims RCA 2.8 RCM 0.0) Nov. 1931 to date with Metropolitan Water Dist. of Southern Calif, as Chainman, Jun. Engr., Inspector, etc.

MALLEY, ALEXIS PETER, San Francisco, Calif. (Age 48) (Claims RCA 12.4 RCM 5.0) Jan. 1934 to date with Public Utilities Comm. as Asst. Hydr. Engr., San Francisco Water Dept., and (since Feb. 1937) Elec. Eng. Designer.

MERRITHEW, WILLIAM STERLING, Pasadena, Calif. (Age 29) (Claims RCA 2.0 RCM 0.0) Feb. 1933 to date with Metropolitan Water Dist. of Southern California as Chainman, Rodman, Instrumentman, Jun. Engr., and (since June 1939) Asst. Engr.

MINAMI, JOHN KAZUO (Junior), Tokyo, Japan. (Age 32) (Claims RCA 5.6 RCM 0.0) April 1937 to date Research Associate, Dept. of Arch., Waseda Univ.; previously with Dr. Tachu Naito, Waseda Univ.

MORRIS, ROBERT DELMER, Ancon, Canal Zone. (Age 35) (Claims RCA 3.5 RCM 0.0) Aug. 1939 to date Engr., U.S. War Dept., Panama Canal Zone, locating highways; previously Engr., U.S. Bureau of Reclamation, All American Canal Project, Yuma, Ariz.; Field Draftsman, Asst. Res. Engr., Instrumentman and Chf. of Party, California Div. of Highways.

MUNGER, HAROLD HAWLEY, Manhattan, Kans. (Age 48) (Claims RC 3.5 D 0.1) 1923 to May 1929 Laboratory Mechanic and Laboratory Asst., and Aug. 1939 to date Graduate Research Asst., Dept. of Applied Mechanics, Kansas State Coll.; in the interim with Dept. of Materials, Kansas State Highway Comm.

PALO, GEORGE PAYNE (Junior), Knoxville, Tenn. (Age 32) (Claims RCA 4.5 RCM 3.0) Dec. 1934 to date with TVA as Asst. Engr., and (since Dec. 1936) Associate Engr.

POLSTEIN, HENRY IRVING, New York City. (Age 34) (Claims RCA 4.8 RCM 0.0) Feb. 1932 to date with King-Taggart Corporation, Bldrs.; previously with Isaac Polstein & Sons, Bldrs.

RAIT, ROBERT ALEXANDER, Lincoln, Nebr. (Age 28) (Claims RCA 2.7 RCM 0.0) Dec. 1936 to date Constr. Engr., Phillips Petroleum Co., Bartlesville, Okla.; previously Constr. Engr., Loup River Public Power Dist.; Inspector of Materials and Constr., U.S. Engrs., Nebraska City, Nebr.

RUDDER, IRVING AVRUM (Junior), New York City. (Age 32) (Claims RCA 4.6 RCM 0.0) Aug. 1938 to date Structural Steel Draftsman, Borough President of Manhattan; previously with Board of Transportation as Jun. Draftsman, Eng. Asst., and Structural Steel Draftsman; with Dept. of Parks (WPA), Topographic Div. as Acting Chf. Draftsman and Superv. Draftsman.

THOMS, JOSEPH CHAK, Malverne, N.Y. (Age 40) (Claims RCA 9.4 RCM 0.0) March 1937 to date Asst. Engr., Levitt & Sons, Inc., Manhassett, N.Y.; previously Structural Designer, Madigan & Hyland, Cons. Engrs., Long Island City, N.Y.; Computor, Long Island State Park Comm., Babylon, N.Y.

VACCARO, GEORGE (Junior), Brooklyn, N.Y. (Age 32) (Claims RCA 1.5 RCM 0.0) Oct. 1938 to date Designer, Board of Transportation, New York City; previously with Gibbs and Hill, Cons. Engrs., as Structural Steel Draftsman, Squad Leader, and Designer; Designing Draftsman, Madigan and Hyland, Cons. Engrs., Long Island City.

VERNER, EDWIN ABERCROMBIE, Berkeley, Calif. (Age 28) (Claims RCA 1.8 RCM 0.0) May 1936 to date Draftsman and Designer successively with various Structural Engrs., Henry J. Kaiser Co., etc., on schools, mill and bank buildings, etc.

WIKSTROM, ARVE SIXTEN (Junior), Bound Brook, N.J. (Age 32) (Claims RCA 4.5 RCM 3.0) 1934 to date in private practice on bridges, grading, road work, and heavy engineering structures.

WILLARD, ROGER HERSPERGER (Junior), Frederick, Md. (Age 32) (Claims RCA 2.7 RCM 2.8) Oct. 1939 to date County Roads Engr., Frederick County, Md.; previously Engr. and Supt., T. Edgie Russell Co.; Asst. Engr., City of Frederick, Md.; with Maryland State Roads Comm. as Inspector and Asst. Supervisor of County Roads.

WILSON, BASIL WRIGLEY, Urbana, Ill. (Age 30) (Claims RC 4.7 D 0.5) Dec. 1937 to date at Univ. of Illinois conducting research on government railway problems, under Commonwealth Fund Service Fellowship (Comm. Fund of New

"In 30 years, I haven't found anything that can touch them on the tough jobs and the long shifts"

—C. T. BURKET

• *The Pennsylvania all-weather highway, where C. T. Burket is further justifying his fourteen years' use of "Caterpillar" equipment! A big cut and a long haul for a bridge-fill being handled by a "Caterpillar" Diesel D7 and a "Caterpillar" Diesel D8 Tractor with LeTourneau Carryall Scrapers. The "Caterpillar" Diesel Tractor, in the background, is specially equipped for blast-hole drilling.*

WHEN Mr. C. T. Burket gave his opinion of "Caterpillar" Diesel Tractors, he was in day-to-day touch with his fleet working near Newville, Pennsylvania, on the all-weather highway. He spoke not only from thirty years of experience—but from on-the-job, up-to-the-minute observations as well!

"I like equipment that needs servicing least and can be serviced quickest," Mr. Burket added. *"That's why you'll find 'Caterpillar' Diesels on my job. They're filling the bill—and cutting it, too."*

Nobody ever gave better reasons than those for using "Caterpillar" Diesels!

Filling the bill, on the all-weather highway, means loading, hauling and spreading heaping payloads over tough grades and tough ground . . . *with power and traction to spare!*

And cutting the bill means two things: a sparing use of low-cost fuel; and the "servicing least" and "serviced quickest" which Mr. Burket talks about!

Thirty years of contracting—*and fourteen of those years with "Caterpillar" equipment*—puts plenty of authority behind Mr. Burket's opinion. It might be a good idea to keep his experience in mind the next time you bid a job . . . *and bid it with "Caterpillar" Diesels!*

CATERPILLAR TRACTOR CO., PEORIA, ILL.

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York); previously with South African Rys. & Harbors as Pupil Engr., Asst. Research Engr., and Acting Research Engr.

WOJDYGO, JOSEPH MORTIMER (Junior), Chicago, Ill. (Age 32) (Claims RCA 5.0 RCM 1.0) June 1928 to date Jun. and Asst. Civ. Engr., San Dist. of Chicago, Sewage-Treatment Plant Design Div.

APPLYING FOR JUNIOR

ALEXANDER, GEORGE WILKINS, Seattle, Wash. (Age 28) 1939 B.S. in Civ. Eng., Univ. of Wash.

ALLEN, ROBERT EWING, Dayton, Ohio. (Age 27) (Claims RCA 1.0 RCM 0.0) Jan. 1935 to date with Soil Conservation Service, U.S. Dept. of Agriculture; since Oct. 1935 as member of Regional Eng. Staff, Ohio Valley Region.

ANDERSON, ERNEST C., Seattle, Wash. (Age 23) 1939 B.S. in C.E., Univ. of Wash.

ARNESON, EDWIN PARK, San Saba, Tex. (Age 22) 1938 B.S., Tex. Agri. and Mech. Coll.; June 1938 to July 1939 Draftsman, Checker and Designer, Bridge Div., and July 1939 to date Instrumentman, Brownwood Dist., Texas State Highway Dept.

BROWN, JAMES GLENN, Charlotte, Mich. (Age 23) 1939 B.S. in Civ. Eng., Ala. Pol. Inst.; Sept. 1939 to date Asst. Sanitarian, Eaton County Health Dept.

BROWN, RICHARD FULMER, Chattanooga, Tenn. (Age 25) 1939 C.E., Univ. of Cin.; Aug. 1939 to date Asst. Eng. Draftsman, TVA, Drafting Sec., Highway and R.R. Div.

CLARK, ROLAND AUGUSTUS, Baltimore, Md. (Age 27) 1936 B.E., The Johns Hopkins Univ.; March 1939 to date Gen. Eng. Draftsman, Whiteman, Requardt & Smith, Engrs.; previously Drafting Supervisor, WPA Project 7043; Chf. of Surveying Party, U.S. Eng. Dept., Army Engrs.; Computer and Draftsman, The Roland Park Co.

DAVIS, THOMAS V., Imperial, Calif. (Age 24) 1938 B.S. in Eng., Calif. Inst. Tech.; Nov. 1937 to date Electrical and Structural Draftsman, Imperial Irrigation Dist.

DECKER, WALTER ALPHONS, Newville, Pa. (Age 22) 1939 B.S. in C.E., Lehigh Univ.

DOUGLASS, PAUL VARNEY, Washington, D.C. (Age 24) (Claims RC 0.2) 1939 B.C.E., Catholic Univ. of America; July 1939 to date Draftsman, U.S. Dept. of Commerce, Bureau of Census.

DOWD, GAYLORD CLARK, Kalamazoo, Mich. (Age 27) (Claims RCA 0.9 RCM 1.3) April 1938 to date Vice-Pres., Stewart-Kingscott Co., Archts. and Engrs.; previously Cartographic Eng. Draftsman, Div. of Highway Planning Survey, Michigan State Highway Dept.; and successively with Andrew Lenderink, Cons. Engr., Kalamazoo Vegetable Parchment Co., and Kalamazoo Fdy. and Machine Co.

HARRIS, LUCIAN JEFFERSON, JR., Birmingham, Ala. (Age 22) 1939 B.S. in C.E., Ga. School Tech.; June 1939 to date Shop Engr., Chicago Bridge & Iron Co.

HOROWITZ, HARRY NATHAN, Seattle, Wash. (Age 25) 1939 B.S. in Civ. Eng., Univ. of Wash.

KOHN, ARTHUR, New Castle, Pa. (Age 23) 1939 B.S. in Civ. Eng., Pa. State Coll.; Aug. 1939 to date Draftsman with The Fleming Structural Steel Co. and on sales.

LESLIE, JOHN WILLIAM, Somerville, Mass. (Age 30) (Claims RCA 2.0 RCM 0.0) Aug. 1936 to Feb. 1937 and May 1937 to date with U.S. Engrs., Boston, Mass., as Dredging Inspector, Jun. Civ. Engr., Jun. Engr., Flood Control Design Div., and (since April 1939) Asst. Civ. Engr.; in the interim Plant Engr., Middlesex Chemical Corporation, Malden, Mass.; previously Jun. Topographic Engr., U.S. Geological Survey.

MACARTNEY, THOMAS WAKEFIELD, Yakima, Wash. (Age 26) 1939 B.S. in Civ. Eng., B.S. in Commercial Eng., and M.S. in Civ. Eng., Univ. of Washington.

OGBURN, THOMAS JEFFERSON, III, Richmond, Va. (Age 25) 1937 B.A., Yale Univ.; June 1936 to date with Virginia State Highway Dept. as Draftsman, and (since July 1938) Jun. Bridge Design Engr.

ROCHEFORD, GEORGE EDWARD, Worcester, Mass. (Age 26) May 1937 to date Field Engr. and Estimator, L. Rocheford & Son, Inc.; previously Jun. Engr., Rockwood Sprinkler Co.

SCHULZ, WILLIAM HAGAN, Louisville, Ky. (Age 23) 1939 B.C.E., Speed Sci. School, Univ. of Louisville.

THOMPSON, WILLIAM ROBERT, Newark, Ohio. (Age 26) 1939 B.C.E., Ohio State Univ.; Sept. 1939 to date Computer, Newark Flood Project, U.S. Engrs.

VICTOR, FRED SAMUEL, JR., East Chicago, Ind. (Age 20) 1939 B.S., Okla. Agri. and Mech. Coll.; June 1939 to date Apprentice Engr., Phillips Petroleum Co.

WEBER, ROBERT CHARLES, Cincinnati, Ohio. (Age 23) 1938 C.E., Univ. of Cin.; Oct. 1938 to date Reinforcing Steel Detailer, The West Virginia Rail Co., Huntington, W.Va.

WISE, HENRY TEGNANDER, Seattle, Wash. (Age 24) 1939 B.S in Civ. Eng., Univ. of Wash.

The Board of Direction will consider the applications in this list not less than thirty days after date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 125 of the 1939 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N. Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

DESIGN

ARCHITECTURAL AND STRUCTURAL ENGINEER; M. Am. Soc. C.E.; University of Pennsylvania graduate, civil engineering; 20 years varied experience with engineers and architect on steel and reinforced concrete design, detailing, and construction; 9 years in one office, responsible for both engineering and architectural work. Also experience in construction work in field. Registered engineer, Pennsylvania. Wishes position with engineer, architect, or contractor. C-614.

STRUCTURAL ENGINEER; M. Am. Soc. C.E.; 35 years experience in design and construction of all types of bridges and buildings, both steel and concrete. Special study and experience in design and construction of indeterminate structures; 20 years as contract and construction executive in sale and erection of fabricated steel; open for immediate engagement any place. C-615.

ARCHITECTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; 33; married; B.A., B.S. (A.E.), M.S., 1930; Chi Epsilon; New Mexico license; 6 years architectural engineering; now working with government architect making estimates, structural analyses, material lists, construction details, and working drawings. Will go anywhere for position with future. C-617.

EXECUTIVE

WATER WORKS ENGINEER; M. Am. Soc. C.E.; registered, Pennsylvania and West Virginia; over 25 years experience, design, construction, and management of water properties. Valuation experience with utilities and public service commission; available now; location anywhere. C-607.

CIVIL ENGINEER; M. Am. Soc. C.E.; 41; graduate; desires connection with highway construction organization; company selling general municipal or highway equipment; 14 years widely varied municipal experience. Marked energy, initiative, ability to mix with all classes and nationalities. Mason, rotarian. Speaks Spanish. Available now. Location anywhere in North or South America. C-608.

CIVIL AND CONSTRUCTION ENGINEER; M. Am. Soc. C.E.; single; 44 years experience in Pacific Coast states in design and construction, investigations, economic studies, valuation and administration of engineering works, railroad, highway, irrigation, domestic water, and municipal; 5$^1/_2$ years with PWA as engineer, regional engineer, and project engineer. C-612.

CIVIL ENGINEERING GRADUATE; Assoc. M. Am. Soc. C.E.; licensed engineer and land surveyor, state of Florida; 11 years experience in office management, design and construction; subdivisions, streets, roads, small bridges, river and harbor work (drilling, blasting, and dredging), steel sheet retaining walls, drainage, industrial piping, sewers, reinforced concrete. Location Southeast. Florida preferred. C-618.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 38; professional license; rotarian; 17 years active practical experience in South, Mid-West, and East; highways, streets, bridges, surveys, zoning, and planning surveys. Location immaterial. Available at once. C-620.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; single; B.S.C.E., Cooper Union, 1934; M.C.E., Brooklyn Polytechnic Institute, 1938; specialized in soil mechanics; 2 years inspection and survey work for tunnel and building construction; 2 years estimating and layout computations for tunnel and heavy construction; 1$^1/_2$ years office engineer on tunnel and other heavy construction. C-609.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; married; B.S.C.E., 1936. Experience: traffic survey, construction foreman and estimator, surveying, steel shop work; 3 years drafting including tanks, machine parts, maps, engraving, advertising copy, show card, etc. Payroll and sales analysis, cost accounting. Drafting equipment design, some machine design. Availeble immediately, any location. C-610.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; single; B.S.C.E., Lafayette College, 1939; specialized in structural engineering; some experience in surveying and in construction of a large industrial plant; several months experience on highway construction. Desires position in design and construction of steel and reinforced concrete structures. Available immediately. Location immaterial. C-611.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 30; married; licensed highway, structural, civil; B.Sc.C.E., University of Wisconsin; 9 years experience, design and construction, earthwork, flood control, pipe lines, concrete paving, highway bridges, surveying, testing materials, inspection, drafting, checking, estimating and supervising; employed; location immaterial; prefers structural work. C-613.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; single; B.S. & M.S. degrees with specialization in structures; 6 months junior designer in reinforced concrete and structural steel; 3 months supervisor on alteration work; 3 months estimator for sewer jobs. Speaks Spanish fluently. Seeks good opportunity regardless of salary. Location immaterial. C-619.

SALES

SALES ENGINEER; Assoc. M. Am. Soc. C.E.; graduate; married; 23 years varied construction, structural design, and sales experience; steel industry; has many contacts in eastern United States and Canada; likes to travel, make technical investigations, write reports; unusual general engineering, and engineering sales experience. C-621.

TEACHING

CIVIL ENGINEER; M. Am. Soc. C.E.; 48; B.S., C.E., M.S.; 13 years successful teaching (one university); 10 years practical experience (field, office, and administrative); at present in charge of half-million-dollar bridge program. C-616.

and cutting it, too."

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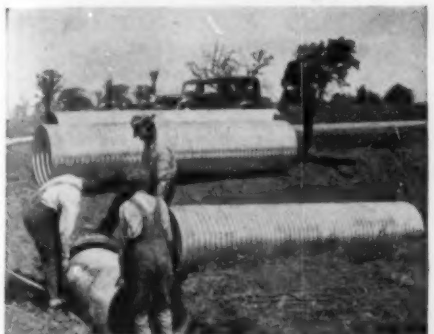
USE THIS HANDY BUYING GUIDE
to Armco Drainage Products



Galvanized Corrugated Pipe: A strong durable pipe for all normal highway and municipal drainage needs. Easily handled in long lengths without special equipment or skilled labor. Supplied with full-weight zinc coating in diameters from 8 to 96 inches and in gages from No. 16 to No. 8.

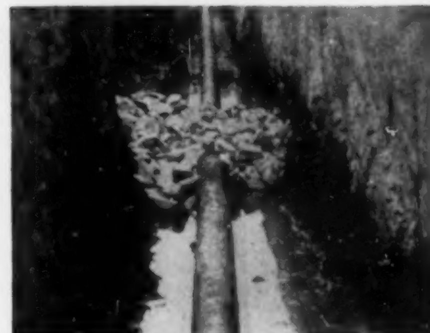
Paved Invert Pipe: An improved drainage structure widely used by street and highway departments. Lasts twice as long as plain galvanized pipe under severe conditions because it has the added protection of a special smooth bituminous pavement in the bottom—where the wear is hardest.

Prompt Service assured by modern plants located throughout country.

ARMCO

• Here's a quick reference to seven Armco products that are saving time and money for thousands of roadbuilders from coast to coast. On this page you'll find a thrifty structure for every problem in drainage or earth control. And remember, with each one you are assured of sound engineering design and expert craftsmanship developed through 33 years of Armco research.

Besides helping you solve your problems faster and at less expense, Armco products give you top performance without maintenance. This is because they are made of galvanized ARMCO Ingot Iron—the *only* low-cost metal proved by a third of a century of service under the roads. Write for free literature. Armco Culvert Mfrs. Assn., Middletown, O.



Perforated Iron Pipe: An efficient subdrainage pipe used to collect and remove harmful seepage water. Rows of perforations in the bottom admit water freely without clogging. Long flexible sections plus strong positive couplings assure a continuous line that will not break or separate.

Multi Plate Pipe: Developed to reduce the cost of large full-round drainage structures up to 15 feet in diameter. Average size installation easily erected in a few days by bolting together thick galvanized iron plates with extra-large corrugations. Plate gages run from No. 12 to No. 1.

Asbestos Bonded Pipe: Assures even greater permanence than standard Paved Invert Pipe because the special bituminous pavement and coating are inseparably "bonded" to the galvanized iron by asbestos fibres. Supplied in regular sizes and gages with a complete line of fittings.

Bin-Type Retaining Walls: An improved cellular wall of iron designed for repairing roadway slips, preventing washouts and solving right-of-way problems. Saves up to 30 per cent in cost and can be erected quickly in any season by local unskilled labor. Self-draining, stable, attractive.

Multi Plate Arches: Used for building, relining or extending large arch-shaped structures with standard Multi Plate sections. Wide variety of span and rise combinations for single waterway openings up to 180 square feet in area. Stone or concrete is used for the foundation and headwalls.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 115 of the Year Book for 1939. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

ELEMENTS OF SANITATION. Edited by E. S. Hopkins. New York, D. Van Nostrand Co., 1939. 435 pp., illus., diagrs., charts, maps, tables, $9^1/_2 \times 6$ in., cloth, $4.

This textbook, intended as a general introduction to the fundamentals of sanitation and hygiene, is the work of a group of specialists. Water and sewage disinfection; public water supplies; the disposal of sewage, trade wastes, and refuse; stream pollution; the sanitation of food and milk; ventilation and air conditioning; the control of swimming pools; and environmental hygiene are discussed.

ENGINEERING: A PROFESSION. Edited by J. Anderson Ashburn. Copyright by *The Michigan Technic*, Ann Arbor, Mich., 1939. 28 pp., paper, 25 cents.

This series of articles is intended as a vocational guide to the young engineer, especially in his selection of the proper functional type of engineering for a profession. There is, also, a brief summary of what industry expects of the engineer. These articles were so well received when they initially appeared in *The Michigan Technic* that the engineering college at the University of Michigan decided to help finance the publication of this booklet in order to make the entire series more conveniently available.

ENGINEERING MATERIALS. By A. H. White. New York and London, McGraw-Hill Book Co., 1939. 547 pp., illus., diagrs., charts, tables, 9×6 in., cloth, $4.50.

The greater part of this book is devoted to the manufacture, heat-treatment, fabrication, and properties of iron, steel, and the non-ferrous metals, with consideration of the effect of methods of fabrication on the physical properties. Subsequent chapters present information on clay products, lime and cements, fuels, water and its industrial utilization, corrosion and protective coatings, and plastics. References accompany each chapter.

GRAPHIC PRESENTATION. By W. C. Brinton. New York, Brinton Associates, 1939, 512 pp., illus., diagrs., charts, tables, $9^1/_2 \times 6$ in., fabrikoid, $5.

A brief encyclopedia of methods for representing facts graphically, which covers a wide range—maps, genealogical charts, statistical charts, etc. Each variety is represented by specimens, with explanations of their uses and interpretation. The use of color is covered. In addition, practical advice is given on equipment and methods for making graphs and exhibits, on reproduction, and on the use of graphic material. There is a short glossary.

Great Britain. Department of Scientific and Industrial Research. REPORT OF THE WATER POLLUTION RESEARCH BOARD FOR THE YEAR ENDED JUNE 30, 1938. London, His Majesty's Stationery Office, 1939. 57 pp., tables, 10×6 in., paper (obtainable from British Library of Information, 50 Rockefeller Plaza, New York, 30 cents).

The work and the progress of investigations in progress during the period are described, with summarized information and data concerning the subjects of milk factory effluents, the activated-sludge process of sewage treatment, colloids in sewage, and the pollution of the estuary of the river Mersey.

HOUSING FOR THE MACHINE AGE. By C. A. Perry. New York, Russell Sage Foundation, 1939. 261 pp., illus., diagrs., charts, tables, maps, 9×6 in., cloth, $2.50.

The problem of modern housing is considered from many angles. Comparison is made between the methods of construction of houses and of automobiles with a view toward mass production. The neighborhood unit is examined, and the results of practical experience are set forth, with particular attention to the matter of assembling large plots in metropolitan districts. The final chapter discusses the social significance of the unit.

JOHNSON'S MATERIALS OF CONSTRUCTION, 8 ed. rewritten and revised. By the late J. B. Johnson, rewritten by M. O. Withey and J. Aston. New York, John Wiley & Sons, 1939. 867 pp., illus., diagrs., charts, tables, $9^1/_2 \times 6$ in., cloth, $6.

This standard work has again been extensively revised in accordance with present-day practice. Essential information is presented concerning the sources, manufacture, and fabrication of the principal materials; selected data covering the more important mechanical and physical properties and the influence of various factors upon these properties are given; the causes of defects and variations are shown, with methods for their discovery; the technique of testing materials is considered; and some of the more general uses of the different materials are given.

KORROSION VII. Bericht über die Korrosionstagung 1938 am 15. November 1938 in Berlin; prepared by Arbeitsgemeinschaft auf dem Gebiete der Korrosion. Berlin, Verein Deutscher Ingenieure, 1939. 81 pp., illus., diagrs., charts, tables, cloth, 6 rm.

This symposium upon corrosion and its prevention contains eighteen papers. Special emphasis is laid upon the effect of corrosion upon the operation of equipment, rather than as a destroyer of material, and upon the need for attention to this effect when designing and constructing apparatus. The effect of corrosion upon gas meters and regulators, water meters, electrical instruments, and so forth is discussed.

LABORATORY MANUAL prepared for Course M.E. 110. By R. G. Folsom and E. H. Taylor. Berkeley, Calif., University of California, Dept. of Mechanical Engineering, Fluid Mechanics Laboratory, 1939. manifold copy, 40 pp., diagrs., charts, tables, 11×9 in., paper, $1.35.

This book describes an elementary course in experimental fluid mechanics, with directions for the experiments. There are three main sections: a brief review of the fundamentals of fluid mechanics, general instructions in laboratory procedure, and descriptions of specific experiments.

MANNING FORMULA TABLES FOR SOLVING HYDRAULIC PROBLEMS. Vol. 2: Flow in Open Channels. By H. W. King. New York and London, McGraw-Hill Book Co., 1939. 379 pp., tables, 9×6 in., leather, $5.

These tables give simple, direct solutions of the problems involving open-channel flow that are commonly encountered in engineering practice. The main table gives a solution of the Manning formula for the range of discharges from less than one to more than 100,000 cu ft per sec. Supplementary tables contain discharge factors that adapt the formula to different types of problems and different forms of sections.

MATERIALS OF CONSTRUCTION. By the late A. P. Mills. 5 ed., rewritten and edited by L. F. Rader. New York, John Wiley & Sons, 1939. 564 pp., illus., diagrs., charts, tables, 9×6 in., cloth, $4.

This general textbook covering the manufacture, properties, and uses of the common materials of engineering construction has been revised and enlarged to include new chapters on the properties of materials and to present information on certain materials not previously covered. Of particular importance is the new section on organic materials, such as protective coatings and plastics.

MY 50 YEARS IN ENGINEERING. By E. A. Hitchcock. Written in collaboration with M. Weed, with introduction by C. F. Kettering. Caldwell (Idaho), Caxton Printers, Ltd., 1939. 222 pp., illus., $9^1/_2 \times 6$ in., cloth, $3.

The life, work, and reminiscences of a distinguished engineer and teacher, whose working life has spanned a period of extremely rapid development in technical lines, are presented in autobiographical form. The varied nature of his activities in railroad, steam power plant, and electric power work, in "human engineering" and teaching, results in a comprehensive survey of the work an engineer may be called upon to do. The narrative is interspersed with philosophical comments.

(THE) NATION'S WATER SUPPLY. By R. C. S. Walters. London, Ivor Nicholson and Watson, 1936. 244 pp., illus., tables, maps, charts, diagrs., 9×6 in., cloth, 31s. 6d.

This is a comprehensive survey of the water supply of Great Britain, intended primarily for the layman who has to deal with water-supply problems and to determine the policy in regard to them. The author first discusses rainfall, geology, and quality in relation to water supply. Attention is then given to the surface, underground, and river resources of the country, and to the schemes adopted and proposed for utilizing them. In conclusion sections are devoted to legislation and to a brief description of the engineering of water-supply works.

PHYSICS, 2 ed. By E. Hausmann and E. P. Slack. New York, D. Van Nostrand Co., 1939. 756 pp., illus., diagrs., charts, tables, 9×6 in., cloth, $4.

The aim of this work is to present the essentials of physics to college students who major in science or engineering. It attempts to give a gradual, logical approach to the subject, and to develop and illustrate clearly the fundamental concepts. The new edition has been revised thoroughly, rearranged in the light of teaching experience, and provided with many additional problems.

PORTLAND CEMENT, 3 ed. By R. K. Meade. New York, Chemical Publishing Co., 1938. 707 pp., illus., diagrs., charts, tables, 10×6 in., cloth, $10.

Apparently a reprinting of the third edition, this standard textbook covers comprehensively the composition, raw materials, manufacture, testing, and analysis of Portland cement. Particular attention is paid to manufacturing processes and equipment, including considerable factual data from existing plants of the period.

PRINCIPLES OF MODERN BUILDING. Vol. 1, Walls, Partitions, and Chimneys. By R. Fitzmaurice. London, Department of Scientific and Industrial Research, His Majesty's Stationery Office, 1939. 420 pp., illus., diagrs., charts, tables, maps, 10×6 in., cloth, $2.90.

This volume is the first of a series which aims at summarizing in a connected manner the knowledge gained from seventeen years of research at the Building Research Station of the British government. The aim of the series is to formulate clearly the functions of a building and of the structural elements that compose it, and thus to produce a statement of the basic principles which should guide the designer. This volume deals with walls, partitions, and chimneys. Various methods of construction are analyzed critically, and the precautions to be observed in the choice and construction of various types of materials are discussed in a practical manner.

ROUTE SURVEYING, 2 ed. By G. W. Pickels and C. C. Wiley. New York, John Wiley & Sons, 1939. 427 pp., illus., diagrs., charts, tables, 7×4 in., leather, $3.50.

In addition to covering railroad surveying, this text includes surveying for highways, transmission lines, pipe lines, and canals. The treatment is concise and practical. Modern methods are presented, without detailed mathematical solutions. In this edition the material on circular curves and spirals has been thoroughly revised and a new chapter added on the string-lining method of realigning curves. Other revisions have been made throughout the book.

SCIENCE AND MECHANISATION IN LAND WARFARE. By D. Portway. New York, Chemical Publishing Co., 1939. 158 pp., diagrs., charts, 9×6 in., fabrikoid, $2.50.

Intended for students in the Cambridge University Officers' Training Corps, this book supplies, in non-technical language, the principles and some of the details underlying the scientific side of modern warfare. The several chapters are devoted to a description of fundamental scientific principles, the importance of railways in war, the various aspects of mechanisation, weather problems, chemical warfare, the work of the army engineer and the signal corps, the artillery survey, and some problems of personnel.

SOCIAL FUNCTION OF SCIENCE. By J. D. Bernal. New York, Macmillan Co., 1939. 482 pp., charts, tables, 9×6 in., cloth, $3.50.

Starting with a brief sketch of the historical development of science, the author proceeds to consider its present organization. He points out numerous reasons for the present confused and inefficient status of scientific research and the forces of prejudice which act in opposition to it. He then discusses certain ways in which a reorganization could be effected with the object of increasing the benefits that society can gain from scientific activity.

TAR ROADS. (The Roadmakers' Library.) By A. C. Hughes, W. G. Adam, and F. J. E. China. London, Edward Arnold & Co.; New York, Longmans, Green & Co., 1938. 196 pp., illus., diagrs., charts, tables, 9×6 in., cloth, $6.50.

The manufacture and use of tar for road work are covered in five sections, of which the first is historical. Part II discusses sources, physical structure, and refining and blending processes, likewise the various mixtures, compounds, and emulsions, and the specification and testing of road tars. Part III describes equipment and the application of tars to roads. Parts IV and V and appendixes cover briefly footpaths, testing of tar-bound materials, and specifications.

VERÖFFENTLICHUNGEN DES INSTITUTS DER DEUTSCHEN FORSCHUNGSGESELLSCHAFT FÜR BODENMECHANIK AN DER TECHNISCHEN HOCHSCHULE BERLIN. Heft 7. Berlin, Julius Springer, 1939. 52 pp., illus., diagrs., charts, tables, 12×9 in., paper, 11.20 rm.

This number contains the following papers: "Bemerkungen über neuere Erddruckuntersuchungen," by A. Hertwig, a critical study of Terzaghi's theory of earth pressure; "Modellversuche über das Zusammenwirken von Mantelreibung, Spitzenwiderstand und Tragfähigkeit von Pfählen," by Rudolf Müller, giving the results of comparative tests of driven piles under controlled conditions; and "Ueber die Scherfestigkeit bindiger Bodenarten," by Hamdi Peynircioglu, describing a new method for studying shear resistance and presenting the results of texts.

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EAKAGE

e generally accepted average of unaccounted- water is 15% of normal consumption. erybody knows that *some* part of unacunted-for water is due to leakage from mains. perienced water works men know that leake is only a small part and that *most* of the accounted-for water is attributable to a riety of other causes, many of which are ecessary and unavoidable.

* * * *

ascertain how much of the 15% average of unacnted-for water is actually due to leakage from water ins, we have recently conducted a leakage test survey cast iron mains in 25 cities in 6 states. The mains ted range from several hundred feet to more than enty miles in length, in sizes from 4″ to 30″ and up to years old, either with no service connections or relaely few that were turned off during the tests. The erage leakage per mile of pipe, per inch of diameter, r 24 hours was 41 gallons—or an average of 380 llons per mile of pipe per day for the sizes tested. his leakage is less than 2% of the average of normal nsumption per mile of distribution main per day. his survey, covering a broad average of water main conuction and substituting facts for guesswork, shows that

bout nine-tenths of all unaccounted-for ater must be attributed to causes other han leakage from cast iron water mains.

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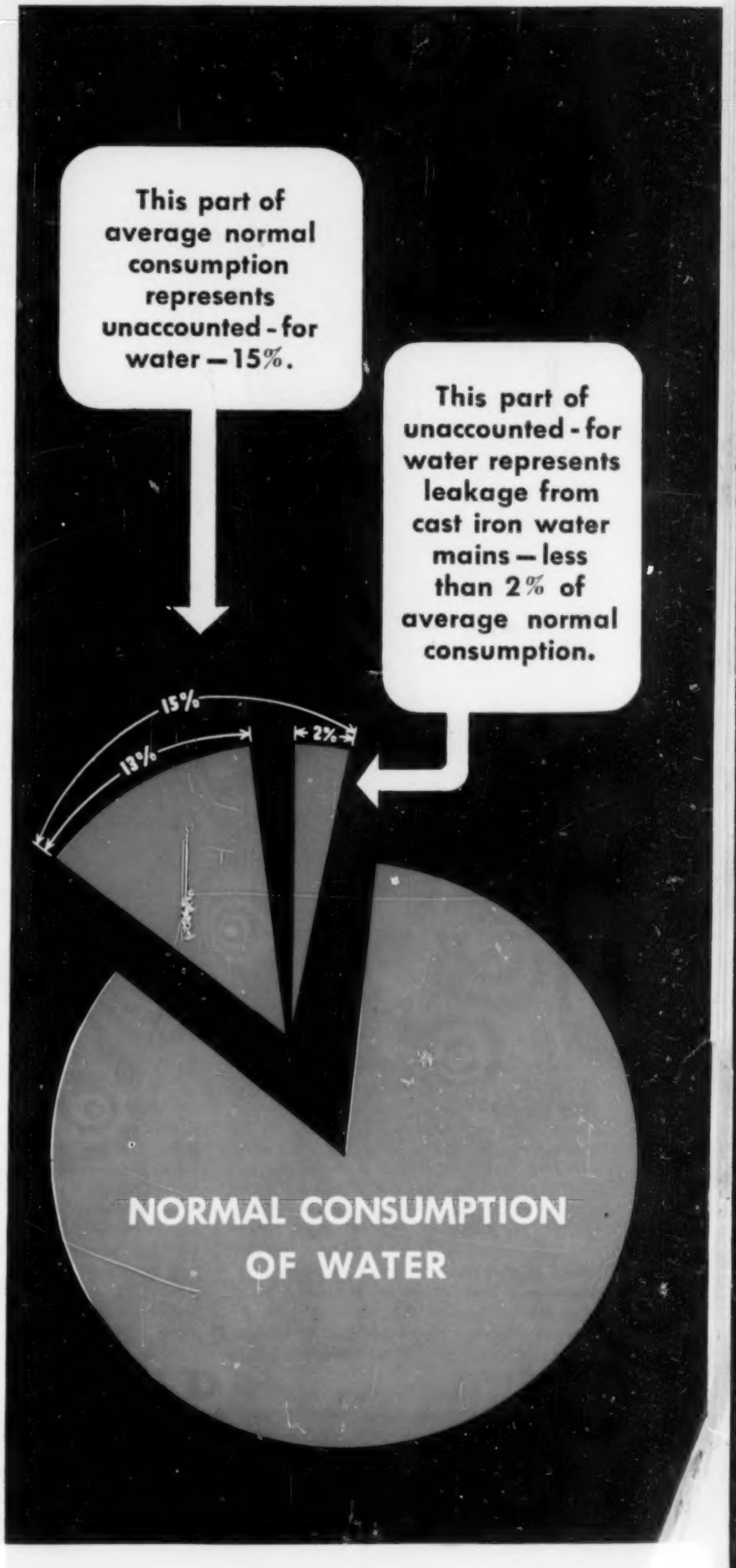


Drawing Instruments

AMERICAN MADE drawing instruments are now in manufacture at the Hoboken, N.J., plant of Keuffel & Esser Co. The new instruments are called "Minusa," a name made by contracting "Made in U.S.A." They have a slender "rounded taper" construction, designed to produce excellent balance and a maximum of strength. Use of a special hard rolled nickel silver stock lends unusual rigidity to compasses, dividers, and springbows. Careful hand fitting of all moving parts insures smooth, even action.

Except for the hand fitting operations, "Minusa" instruments are made by modern machine production methods throughout—a new technique that is said to represent a distinct engineering achievement based on detailed study by the manufacturer over a period of many years. For over a century most of the drawing instruments used in America have been imported from Europe, where they are still virtually made by hand.

Although the first sets are already in the hands of key dealers and volume production is now under way, until manufacturing facilities can be extended, "Minusa" instruments will be offered in complete ten-piece sets only. Single exception is the large ruling pen, now available.

Industrial Tractor

A NEW INDUSTRIAL TRACTOR, Model "IB," has been introduced by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. The Model "IB" is specifically designed as an industrial tractor and is built low, short, compact, and powerful to handle all types of industrial work.

With 13.5 drawbar h.p., and weighing 2140 lbs, this versatile unit is said to speed up hauling operations and cut material handling costs in foundries, manufacturing plants, parks, airports, and on other jobs requiring low cost tractive power.

A structural steel frame surrounding the engine and radiator can be provided so that extra equipment—snowplows, brooms, compressors, and highway mowers—can be mounted. This frame also protects the vital parts of the tractor and serves as a bumper for pushing jobs.

For power the "IB" has an 18 h.p. heavy duty, medium speed tractor engine. This husky valve-in-head engine has removable cylinder liners, a foot controlled governor, and is protected by oil, air, and fuel filters. Although the tractor develops 13.5 h.p. at the drawbar, fuel consumption is less than one gal per hr. The "IB" is equipped with a muffler, foot accelerator, and seat, and can be equipped with numerous other accessories, such as power take-off, belt pulley, generator, lights, and wheel weights.

Acetylene Generator

A NEW ACETYLENE generator, known as the Oxweld MP-9 Medium-Pressure Acetylene Generator, and designed to combine portability with the operating advantages usually found only in larger units, has just been announced by The Linde Air Products Co., New York, N.Y. The MP-9 weighs only 129 lbs, and can readily be moved about the shop or in the field. It holds 25 lb of size 14 ND Union Carbide and will deliver as much as 50 cu ft of acetylene per hr. at any desired pressure up to 15 lb per sq in. Several hours of continuous welding or cutting on all except the heaviest work can be obtained from one charging.

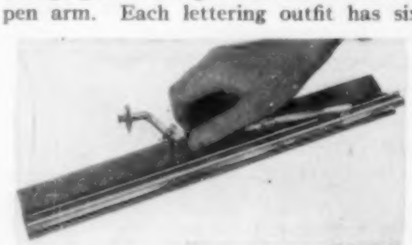
Sturdy Clamshell

A NEW FEATURE in clamshell bucket design, announced by the Blaw-Knox Co., Pittsburgh, Pa., aims to reduce maintenance problems resulting from the practice of "dropping the bucket."

In most digging and excavating work it is customary for the crane operator to drop the bucket to insure the advantage of good initial penetration. As a result of these impact and shock stresses, the bucket's head construction frequently becomes loose and wobbly. A practical solution to this problem has been the objective of a new type of lever arm bucket recently developed by the Blaw-Knox Co. In this bucket, all four corner bars are mounted directly on the head pin. The cast steel head block, when secured in position, joins one pair of corner bars together in such a manner that a rigid A-frame assembly is obtained. It is claimed that this improved form of construction not only provides for a direct transmittal of stress and shock between head pin and corner pins, but also insures a rigidity which maintains permanently true alignment between the upper sheaves and lower sheaves—thus obtaining long cable life.

Lettering Set

AN ECONOMICAL LETTERING set is announced by the Eugene Dietzgen Co., Chicago, Ill. A feature of the Edco "Spee-dee" Lettering Set is that with one single guide it is possible to produce eight different types of lettering simply by changing the setting of the tracer and the pen arm. Each lettering outfit has six



different weights of pen points from extra light to extra bold, thus making 48 different weights and styles of type available. Letters are formed in one continuous movement without shifting the guide, and proper positioning and spacing of letters are made by the spacing markers. The outfit is packed in a portable mahogany case, complete with all supplies.

Literature Available

CHEMICAL FEED—An accurate and reliable feed made for apportioning chemicals in wet form at a constant or variable rate is described in an eight-page booklet. Permutit Co., 330 West 42d St., New York, N.Y.

COATINGS—The advantages, applications, tests and specifications of "Plastex" Protective Coatings are covered in a comprehensive bulletin. Steel Protection & Chemical Co., Inc., Mooresville, Ind.

CONCRETE PIPE—A description of carrying capacity tests made on three Lock Joint Pipe lines in Denver is given in a concise bulletin. Lock Joint Pipe Co., Ampere, N.J.

CORROSION RESISTANCE—"The Resistance of Ni-Resist to Corrosion by Sewage," is the title of a bulletin describing the properties of this alloy cast iron and its applications for sewage treatment equipment. International Nickel Co., 67 Wall St., New York, N.Y.

DRAGLINES—A 32-page bulletin, No. DL-1, describes the mechanical and structural details of Bucyrus-Erie draglines in various sizes. Bucyrus-Erie Co., South Milwaukee, Wis.

HIGH-EARLY-STRENGTH CEMENT—A 16-page booklet explains what high-early-strength cement is; lists its advantages and benefits to engineers, contractors, and property owners; and includes helpful data pertaining to cold weather concreting and the production of watertight concrete. Pennsylvania-Dixie Cement Corpn., 60 East 42d St., New York, N.Y.

PAINT—A four-page catalog section on its line of Acidseal Paints, derived from rubber by a process which it developed and patented, has just been published by The B. F. Goodrich Co., Akron, Ohio.

PIPE—An attractive two-color, 44-page catalog, "Toncan Iron Pipe for Tough Service," covers rust and corrosion resistance; recommended applications; details of various tests; physical properties; and other information. Republic Steel Corp., Advertising Division, Cleveland, Ohio.

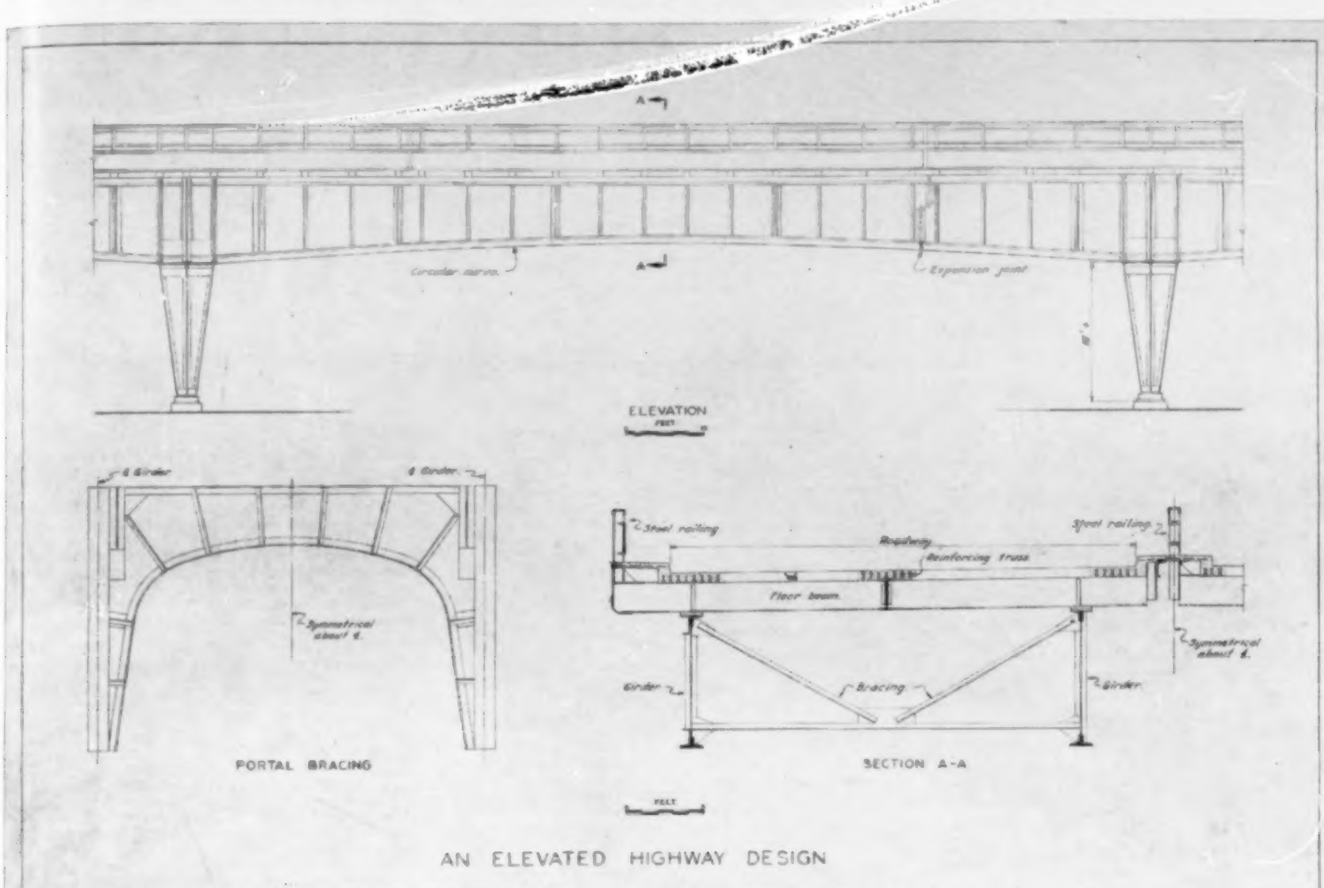
PUMPS—A catalog of sixty-four pages covers the full line of Peerless Pumps, including water-lubricated turbines, oil-lubricated turbines, propeller pumps, mine pumps and the new Hi-Light Pump. Peerless Pump Div., Food Machinery Corp., 301 West Ave. 26, Los Angeles, Calif.

SEWAGE DISPOSAL GAUGES AND METERS—A 16-page illustrated bulletin, No. 232, covers instrumentation in the complete operation of sewage disposal from raw sewage entering the system to the incineration of the processed sludge. The Foxboro Co., Foxboro, Mass.

SOIL-CEMENT ROADS—How to build low-cost roads for light traffic by mixing roadway soil with portland cement and water is told in detail in a 90-page manual just issued by the Portland Cement Association, 33 West Grand Ave., Chicago, Ill.

WELDING IDEAS—A new bulletin, "101 Welding Ideas for Low-Cost Maintenance," which illustrates and describes a wide variety of money-saving repair, fabrication and structural applications of arc welding, has just been published by The Lincoln Electric Co., Cleveland, Ohio.

*TYPHONITE ELDORADO PENCIL PAGE



THIS DRAWING WAS MADE WITH TYPHONITE ELDORADO USING DEGREES HB, F, 2H AND 3H

HERE is an elevated highway design, a combination of rigid frame and cantilever construction, which is light and graceful in appearance, very strong and yet economical. It permits spans to be from 125 to 200 feet long, which is 75% to 100% longer than simple spans, without increasing material. The drawing was made with *Typhonite Eldorado, using degrees HB, F, 2H and 3H.

The long spans, of course, decrease the number of columns with their foundations, and the number of expansion joints required. Curbed bottom of girder has pleasing appearance and gives the girder its maximum depth at the column where the greatest bending moment and shear occur. The rigid frame action locks the units in place longitudinally, and all bending from wind pressure is taken by the structure. It is adaptable to all types of foundations, from piles to footing on solid rock.

Columns are tapered to appear functional. This shape shows their action because they are fixed at their tops and so have decreasing bending to zero at the bottom. Portal bracing gives lateral support to columns and harmonizes with lines of main structure.

The comparatively thin roadway slab used to reduce the dead load is achieved by use of reinforcing trusses. Floor beams are cantilevered to increase the appearance of lightness and also to provide for a wider roadway more economically.

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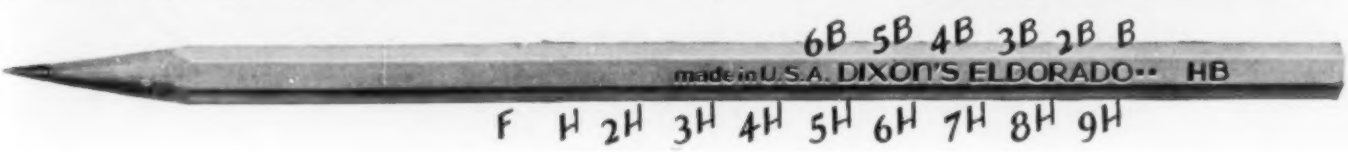

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BRIDGES

BEARINGS. Gepanzerte Betonwaelzgelenke, -pendel und -rollenlager, E. Burkhardt. *Bautechnik*, vol. 17, no. 16, Apr. 14, 1939, pp. 230–235. Review of modern German practice in design and construction of armored concrete bearings of rocker and roller types, for concrete bridges of various designs.

CONCRETE, FRANCE. Bridge over Marne at Bry. *Engineer*, vol. 168, no. 4359, July 28, 1939, p. 100. Illustrated description of bridge of cantilever type; consists of central suspended span; total length 370 ft; decking comprises 33-ft reinforced concrete vaulted slab supporting roadway.

CONCRETE, WATERPROOFING. Beitrag zur Abdichtung der Eisenbeton-Strassenbruecken, W. Haussmann. *Bauingenieur*, vol. 20, no. 27/28, July 14, 1939, pp. 359–366. Review of modern German practice in draining and waterproofing of reinforced concrete highway bridges.

FOOTBRIDGES. Holzbruecke fuer Fussgaenger ueber den Mittellandkanal, H. Simons. *Bauingenieur*, vol. 20, no. 25/26, June 30, 1939, pp. 331–333. Design and construction of timber truss footbridges over Mittelland Canal, Germany; use of metallic connectors.

MAINTENANCE AND REPAIR. Maintenance Experience on 120 Bridges. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, pp. 88–90. Experience of Seattle, Wash., in operating and maintaining bridges of wood, steel, and concrete; bridge record system; recording data relative to traffic and boat accidents that occur on bridges; protecting working surfaces of expansion joints; painting steel bridges; batch formulas for Seattle bridge paint.

BUILDINGS

LIGHTING EXHIBITIONS. Exterior Illumination of Golden Gate International Exposition, San Francisco, California, A. F. Dickerson. *Illum. Eng. Soc.—Trans.*, vol. 34, no. 7, July 1939, pp. 681–708. Survey by independent agency recently revealed that lighting was leader of exposition's many attractions; presents general statement of outdoor lighting scheme and gives detailed descriptions of effects and equipment used in various courts and sections of grounds.

LIGHTING EXHIBITIONS. How New York World's Fair Exhibitors Use Light, S. G. Hibben. *Illum. Eng. Soc.—Trans.*, vol. 34, no. 8, Sept. 1939, pp. 855–860. Notes on water lighting, use of high intensity mercury lamps, fluorescent lamp applications, luminescence and "black light," treatment of ornamental towers, dioramas and surface treatments, ice cube architecture, etc.

RECONSTRUCTION. Removing Columns from Tall Building, R. G. Lose. *Eng. News-Rec.*, vol. 123, no. 13, Sept. 28, 1939, pp. 46–47. Method of removing first-story portions of two reinforced concrete columns in modernizing 13-story reinforced concrete Ansley Hotel in Atlanta, Ga.; steel girder and column bents were installed to pick up loads at second-story transfer of load between concrete column and steel girders through steel plate jacket equipped with lugs that fit into sawed chases in concrete.

ROOFS, ARCH. Eight Radial Roof Trusses Without Common Center. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, p. 93. Design of novel support for roof of auditorium at San Francisco World's Fair; consists of four pairs of radial trusses, each pair combined into 3-hinged arch; joint details for radial trusses.

THEATERS, STAGE EQUIPMENT. Engineering on Stage, R. G. Williams. *Junior Instn. Engrs.—J.*, vol. 49, pt. 11, Aug. 1939, pp. 495–509. Type of stage fitted with facilities for "flying" scenery and curtains, known as grid type, dealt with; stage construction; cycloramas; rolling and revolving stages; stage control; electric equipment.

CITY AND REGIONAL PLANNING

UNITED STATES. Regional Planning—Pt. VIII, Northern Lakes States. Washington (D.C.), U.S. Government Printing Office, May 1939, 63 pp. 25 cents. Economic and social conditions of cut-over area in northern Michigan, Wisconsin, and Minnesota; people and their problems; land use; industry, transportation, and power; local government; taxation; grants in aid.

WATER WORKS, MANAGEMENT. Planning Water Works Property Development, C. J. Alfke. *Am. Water Works Assn.—J.*, vol. 31, no. 8, Aug. 1939, pp. 1271–1278. Review of developments in United States affecting consumption of water and population growth; up-to-date estimates of population changes; factors in population change; population redistribution.

CONCRETE

MIXING. Modern Concrete Practice, T. H. Cross. *Junior Instn. Engrs.—J.*, vol. 49, pt. 10, July 1939, pp. 458–470. Mixing methods and their relations to strengths obtainable in product; results of extensive tests with truck mixers.

REINFORCEMENT, WELDING. La soudure appliquée au beton armé. *Travaux*, vol. 23, no. 80, Aug. 1939, pp. 332–336. Symposium and application of welding of steel reinforcement in concrete construction, including following: Welding of Concrete Reinforcement Bars, Lebrun; Use of Welded Frames for Reinforced Concrete, Eteve; Conclusions, Freyssinet.

ROADS AND STREETS. Thickened-Edge Pavements Failure, W. S. Downs. *Eng. News-Rec.*, vol. 123, no. 5, Aug. 3, 1939, p. 60. Basing his comments on careful inspection of thousands of miles of pavement during the past 5 years, author classes thickened edge pavement as design failure; uniformly thick pavements promise longer life and better service.

SLAG. Lean and Wet Slag Mix Makes Good Concrete, J. K. Harris. *Eng. News-Rec.*, vol. 123, no. 9, Aug. 31, 1939, pp. 47–48. Favorable experience with slag concrete in foundations of Republic Steel Corporation mill at Cleveland, Ohio; low cement content contributing to economy and wet consistency; substitution of fine graded slag for 20 per cent of coarse slag improved workability and gave maximum density.

WATERPROOFING. Waterproofing Cement and Concrete, P. G. Pigache. *Concrete & Constr. Engr.*, vol. 34, no. 7, July 1939, pp. 402–403. Use of colloidal sodium alginate, produced from seaweed, for waterproofing of concrete and cement structures.

DAMS

CONCRETE GRAVITY, ELEVATORS. Elevator Rides Dam Face, C. E. Blee. *Eng. News-Rec.*, vol. 123, no. 13, Sept. 28, 1939, p. 74. Features of materials elevators, for light and for heavy duty, developed to operate to top of concrete face, for use in construction of spillway of Hiwassee Dam, North Carolina.

CONCRETE GRAVITY, TENNESSEE VALLEY AUTHORITY. Crackless Concrete for Hiwassee Dam. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, pp. 69–72. Use of low heat cement, refrigerated mixing water, and various expedients to reduce temperature rise of setting concrete in construction of Hiwassee concrete gravity dam of Tennessee Valley Authority, having maximum height of 370 ft, length of 1,292 ft.

CONCRETE GRAVITY, WASHINGTON. Handy A-Frames for Form Panels. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, p. 94. Description of A-frames for raising 25-ft form panels on Grand Coulee Dam made up with 2-in. pipe welded up-on job.

CONCRETE, TURKEY. Irrigation Dam at Chubuk. *Engineer*, vol. 168, no. 4359, July 28, 1939, pp. 99–102. Illustrated description of scheme to provide regular water supply to Ankara and surrounding region; foundations of dam are made in concrete of same characteristics, over which layer of concrete in mix containing trass has been laid; upstream face is built perfectly vertical, while downstream face is at angle of 53 deg; gallery runs along top of wall; there are five overflow chutes, each topped by sluice gate.

Earth, Design. Design and Maintenance of Earth Dams, W. P. Creager. *Am. Water Works Assn.—J.*, vol. 31, no. 8, Aug. 1939, pp. 1335–1358, (discussion) 1359–1360. Basic principles involved in design and maintenance of earth dams; analysis of seepage forces in homogeneous dam on impervious foundation; amount and velocity of seepage; piping; stability of slopes; foundations; warning of earth movement; permissible saturation in dams; spillway control; theory of probabilities applied to flood studies; operating routine. Bibliography.

Earth, Rhode Island. Welded Iron Waterstop for Earth Dam. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, pp. 90–91. Construction of earth dam in Rhode Island, 25 ft maximum height, 450 ft long, having waterstop of welded sheets of iron.

FLOOD CONTROL

Guntersville, Ala. Backwater Protection for Guntersville. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, pp. 80–82. Outline of rearrangements to protect private and municipal property and facilities at Guntersville, Ala., due to backwater of reservoir above nearly completed Guntersville Dam of Tennessee Valley Authority, involving expenditure of about $1,000,000; dikes to protect low-lying areas; reconstruction of town's sewer and water systems.

FLOW OF FLUIDS

Open Channels. Der Abfluss in eisernen Spundwandkanaelen, F. von Buelow. *Bautechnik*, vol. 17, no. 17, Apr. 21, 1939, pp. 248–250. Discussion of roughness coefficient appearing in several accepted formulas of flow of water in open channels; experimental determination of roughness coefficient in models of open channels confined between walls of steel sheet piling.

FOUNDATIONS

Bridge Piers. Deep Caisson Work at Whitestone Bridge, G. L. Freeman. *Eng. News.-Rec.*, vol. 123, no. 5, Aug. 3, 1939, pp. 55–59. Description of foundations for new Bronx-Whitestone suspension bridge, New York City, including square, rectangular, and circular concrete caissons and square hollow wall-welded steel box caissons; vertical jetting wells and horizontal jetting nozzles in walls aiding caisson sinking through difficult material; sinking rates of Whitestone caissons.

Bridge Piers, Construction. Cofferdam Sealed in Novel Way, R. J. Reigeluth. *Eng. News-Rec.*, vol. 123, no. 5, Aug. 3, 1939, p. 67. Method of placing ring seal of concrete around inside of sheet-pile cofferdam in construction of piers for Ferry St. bascule bridge in New Haven, Conn.

Consolidation. Grouting with Chemicals, J. D. Lewin. *Eng. News-Rec.*, vol. 123, no. 7, Aug. 17, 1939, pp. 61–62. Review of European processes for consolidation of soils by chemicals, usually sodium silicate in combination with calcium chloride or some heavy metal salt; controlling time of set with two chemicals injected simultaneously instead of separately; examples of stopping of seepage, improvement of strata, increasing bearing of existing piles, preventing movement of quicksand, etc.

Design. Ingenious Cantilever Foundation, J. Lasker. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, pp. 86–87. Extension of L-street steam electric plant of Boston Edison Company; description of cantilever foundation designed to straddle existing chimney footing and relieve it of any building load.

Pile. Computing Pile Groups, C. E. Sharp, Jr. *Eng. News-Rec.*, vol. 123, no. 5, Aug. 3, 1939, p. 75. Simple formulas for computing section modulus of symmetrical pile or rivet groups.

HYDRAULIC ENGINEERING

Cavitation. Hohlsog-(Kavitations-) bildung in Lufthaltigem Wasser, F. Gutsche. *Schiffbau*, vol. 40, no. 11, June 1, 1939, pp. 196–200. Cavitation formation in water containing air; reference to work of F. Numachi and results of author's observations; remarks on practical determination of air content of water.

Flow of Fluids. Outlook in Fluid Mechanics, W. F. Durand. *Franklin Inst.—J.*, vol. 228, no. 2, Aug. 1939, pp. 183–212. General non-mathematical discussion of characteristics of laminar and turbulent flow of fluids, indicating necessary and promising lines of progress.

Open Channels. Flow of Water in Irrigation and Similar Canals, F. C. Scobey. *U.S. Dept. Agric.—Tech. Bul. no. 652*, Feb. 1939, 78 pp., 20 cents. Results of tests made since 1913 on canals conveying clear and muddy waters in shot- and poured-concrete sections, and canals of excessively sinuous line; design and operation of open canals; capacity formulas; equipment and methods; collecting field data; determining progressive values of *n* in same location; regional characteristics influencing canal capacity; recommendations for values of *n* variations of *n* in same canal. Bibliography.

Testing Ship Models. Systematische Modellschleppversuche mit kleinen seegehenden Frachtschiffen, J. G. Koning. *Schiffbau*, vol. 40, no. 12, June 15, 1939, pp. 229–232. Systematic model towing tests with small sea-going cargo ships; review of report of Netherlands Model Tank in Wageningen; charts and tables presented.

HYDROLOGY AND METEOROLOGY

Earthquakes, Chile. Perjuicios del terremoto del 24 de Enero ultimo en las construcciones y como pudieron evitarse, E. Aguirre S. *Anales del Instituto de Ingenieros de Chile*, vol. 39, nos. 7–8, July–August 1939, pp. 349–365. Damages to structures, caused by earthquake of Jan. 24, last, and how they might have been averted; causes of earthquakes; nature of seismic movements; earthquake recording; effect on structures; quake of Jan. 24, 1939, and its effects; means of correcting defects, in different types of buildings and structures; recommendations as to materials and design.

Rain and Rainfall, Periodicity. Varves and Rock Strata as Recorders of Cycles, H. P. Gillette. *Roads & Streets*, vol. 82, no. 7, July 1939, pp. 38–40, 42, and 44. Paper pointing out rainfall and weather cycles on basis of measurements of thickness of varves, geological rock strata, etc. Before Am. Meteorological Soc.

Rain and Rainfall, United States. Rainfall and Runoff of New England, A. T. Safford. *Boston Soc. Civ. Engrs.—J.*, vol. 26, no. 2, sec. 2, Apr. 1939, pp. 1–101. Re-study of data on rainfall and runoff of New England bringing up to date report, to Boston Society of Civil Engineers, published in *Journal of Society* for October 1922; figures for subsequent 15 years; conclusions of former report tested out and strengthened or questioned; new conclusions; drought conditions in United States; dry and wet cycles; runoff vs. drainage area; evaporation; effect of reforestation.

IRRIGATION

Moisture Control. Soil Moisture Control by Irrigation, R. A. Work. *Agric. Eng.*, vol. 20, no. 9, Sept. 1939, pp. 359–362. Report on cooperative experiments by U.S. Bureau of Agricultural Engineering and Oregon Agricultural Experiment Station to determine when and in what amounts water should be applied for maximum production of pears of good storage and desert quality; moisture determination as guide to irrigation; influence of various irrigation practices. Bibliography. Before Am. Soc. Agric. Engrs.

LAND RECLAMATION AND DRAINAGE

Tests. Testing Program Used to Determine Treasure Island Drainage Procedure, C. H. Lee. *Western Construction News*, vol. 14, no. 7, July 1939, pp. 230–234. Reports on study of open-drain ditches, cased wells, and well points for most economical method of lowering water table and reducing salt content in hydraulic-fill island for Golden Gate Exposition: composition of dredger fill; drainage tests; mechanical analyses of Treasure Island soils; pumping operations; leaching experiments; sprinkling system for artificial leaching.

MUNICIPAL ENGINEERING

Miami, Fla. Public Works Geared to Growth. *Eng. News-Rec.*, vol. 123, no. 13, Sept. 28, 1939, pp. 71–73. Review of recent municipal improvements in Miami, Fla.; storm drainage facilities; power from refuse; private water distribution.

PORTS AND MARITIME STRUCTURES

Denmark. Der Hafen von Fredericia, A. Grum-Schwensen. *Bauingenieur*, vol. 20, no. 27/28, July 14, 1939, pp. 370–375. Historical development of port in city of Fredericia, Denmark, since seventeenth century, with special reference to new construction and extensions between 1937 and 1939.

ROADS AND STREETS

Snow Removal. Communication Important Snow Control Factor. *Roads & Streets*, vol. 82, no. 8, Aug. 1939, pp. 25–28. Use of radio equipment in organization of snow removal operations and winter maintenance in mountain roads of eastern California.

Snow Removal. Control of Icy Conditions on Roads. *Roads & Streets*, vol. 82, no. 8, Aug. 1939, pp. 43–46. Summary of practice of state highway departments of 24 states.

Snow Removal. Snow Removal in Rocky Mountains, C. E. Learned. *Roads & Streets*, vol. 82, no. 8, Aug. 1939, pp. 39–42. Organization of snow control and snow removal on transcontinental highways over high mountain passes of Continental Divide; cost data.

SANITARY ENGINEERING

Water Works, Management. Potential Health Hazards in Distribution of Water, A. E. Gorman. *Am. Water Works Assn.—J.*, vol. 31, no. 7, July 1939, pp. 1143–1155. Review of weaknesses in system of distributing or retailing water, particularly as they may concern public health; potential dangers and actual outbreaks; axioms for prevention of health hazards; hazards in design; installation hazards; hazards in operation; hazards on consumer's premises; danger in repumping.

SEWERAGE AND SEWAGE DISPOSAL

Activated Sludge. Activated Sludge Oxidations—III, C. N. Sawyer. *Sewage Works J.*, vol.

TIDE-GATES

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11, no. 4, July 1939, pp. 595–606. Experimental study of factors involved in prolonging initial high rate of oxygen utilization by activated sludge sewage mixtures; cause of maximum oxygen utilization. Bibliography.

ACTIVATED SLUDGE. Design of Air Distribution Systems for Activated Sludge Plants, H. R. King. *Water Works & Sewerage*, vol. 86, no. 7, July 1939, pp. 243–249. Pressure losses in flow of air and their consideration in design of air-distribution system for activated sludge plant; determining layout for any air-distribution system, regardless of arrangement of diffusers in aeration tanks; air piping and diffusers for plant employing spiral-flow aeration tanks; frequency of cleaning; losses caused by valves, fittings, and meters; economical pipe sizing; cost of throttling.

CUBA. Sewage Treatment in Cuba, A. P. Black. *Mun. Sanitation*, vol. 10, no. 8, Aug. 1939, pp. 397–398. Comparative review of Cuban and American sewage treatment practices; sewage and trade waste problems in Cuba; various types of wash; coagulants in sewage treatment; Miami Beach sewer outfall.

DILUTION. Storage Lake Aids Stream Purification, G. M. Ridenour. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, pp. 91–93. Data on usefulness of lakes as natural purification medium obtained from long-time study of impounding reservoir which receives effluent from sewage disposal plant at Greystone Park Hospital, New Jersey; character of sludge deposits; sludge bank formation; dissolved oxygen saturation in stream with and without benefit of natural storage.

DISPOSAL PLANTS, GAS ENGINES. Sludge and City Gas Give New York 3840 Hp. *Power*, vol. 83, no. 5, May 1939, pp. 58–61. Tallman's Island plant in New York City generates power from sludge gas, housing 3,840 hp in gas engines driving sewage pumps and blowers; typical layouts and fuel piping illustrated.

DISPOSAL PLANTS, LABORATORIES. Test Tube Technique in Sewage Treatment Research, E. J. Cleary. *Eng. News-Rec.*, vol. 123, no. 9, Aug. 31, 1939, pp. 74–75. Description of new research laboratory of New Jersey Sewage Experiment Station occupying portion of abandoned factory building; principal equipment and studies.

FILTRATION PLANTS, CINCINNATI, OHIO. 30-Year Old Filter Plant Remodeled, C. Bahlman. *Water Works Eng.*, vol. 92, no. 15, July 19, 1939, pp. 916–920 and 925. Modernization and enlargement of water filtration plant in Cincinnati, Ohio, to capacity of 156 mgd, costing $3,250,000; first year's operating experiences.

FILTRATION PLANTS, COVINGTON, KY. Filter Plant Results at Covington, N. N. Wolpert. *Water Works Eng.*, vol. 92, no. 15, July 10, 1939, pp. 921–924. Description of new 19-mgd water filtration plant of Covington, Ky.; data on year's operation problems in treating Ohio River water; backwashing and pumping equipment; control of pollution; treatment with chloramines.

GAS RECOVERY. Gas Hazards and Their Elimination. *Mun. Sanitation*, vol. 10, nos. 8, 9, and 10, Aug. 1939, pp. 394–396, (discussions) Sept. pp. 453–454, and Oct. pp. 489–490. Results of studies by Joint Committee on Gas Hazards of New Jersey Sewage Works Association; instructions to operators and superintendents of sewage systems and sewage treatment plants; recommended principles for safe design and gas-handling equipment at sewage treatment plants.

INDUSTRIAL WASTE. Ordinances to Control Industrial Wastes. *Mun. Sanitation*, vol. 10, no. 8, Aug. 1939, pp. 413–415. Practical discussion by sewage disposal plant superintendents of ordinances to control industrial wastes admitted to sewers; limits imposed on solids, oils, greases, acids, alkalies, inflammable and indigestible organic wastes; operating difficulties; percentage of industrial wastes to domestic sewage.

INDUSTRIAL WASTE. Recent Developments in Trade Waste Treatment Methods, E. W. Moore. *Boston Soc. Civ. Engrs.—J.*, vol. 26, no. 3, July 1939, pp. 224–235. Review of recent developments in disposal of industrial wastes from milk plants, slaughter and packing houses, distilleries, metallurgical plants, tanneries, textile mills, and laundries. Bibliography.

INDUSTRIAL WASTES. Treating Heavy Industrial Wastes Load, A. J. Gadomski. *Mun. Sanitation*, vol. 10, no. 10, Oct. 1939, pp. 485–487. Equipment and operation of 20-mgd sewage disposal plant of Perth Amboy, N.J.; sedimentation units; chemical treatment; sewage characteristics; sludge dewatering.

PLANTS, ACCIDENT PREVENTION. Injuries in Sewers and Sewage Treatment Plants. *Mun. Sanitation*, vol. 10, no. 10, Oct. 1939, pp. 499–501. Discussion by sewage disposal plant superintendents of nature of usual injuries at sewage treatment and sewer maintenance works; compensation; correction of accident hazards.

PLANTS, CALIFORNIA. Small Sewage Treatment Plants in California. *Sewage Works J.*, vol. 11, no. 4, July 1939, pp. 675–680. Symposium including following papers: Wasco Treatment Plant, T. Mathews; Visalia Plant, N. A. Huth; Delano Plant, G. Johnson; Tehachapi Sewage Treatment Plant, C. S. Chitwood; Sewage Works Improvements for City of Bakersfield, J. Holfelder.

PLANTS, DETROIT, MICH. Detroit Sewage Disposal Project, G. R. Thompson. *Sewage Works J.*, vol. 11, no. 4, July 1939, pp. 607–608. History and principal features of sewage disposal project of Detroit, Mich., which will ultimately serve population of 2,400,000.

PLANTS, OPERATION. Observations on Operation of Institutional Sewage Treatment Plants, J. H. L. Giles. *Sewage Works J.*, vol. 11, no. 4, July 1939, pp. 636–645. Features of several typical institutional plants built by Connecticut State Department of Health.

PLANTS, RHODE ISLAND. Sewer Design and Construction—1939 Model, E. J. Cleary. *Eng. News Rec.*, vol. 123, no. 13, Sept. 28, 1939, pp. 65–70. Design and construction of modern sewage disposal system for Cranston, R. I. (population 50,000), which heretofore had been largest city in United States having no municipal sewerage facilities; standards for design and installation of sewer structures; job organization; field location of sewer; making service connections.

PLANTS, RIVER FALLS, WIS. High Capacity Filtration, Without Sludge Digestion, H. O. Halvorson and R. L. Smith. *Mun. Sanitation*, vol. 10, no. 9, Sept. 1939, pp. 438–440. Description of new sewage disposal plant of River Falls, Wis., population 3,000, in which wastes are treated by aerobic processes only, flocculated organic matter being removed and treated without digestion; operating results; effect of ferric chloride and copper sulfate on bacterial counts in sludge; effect of chemicals on sludge; costs of construction and operation.

PLANTS, YAKIMA, WASH. Northwest's Largest Plant Treats Cannery Wastes, R. E. Koon. *Mun. Sanitation*, vol. 10, no. 8, Aug. 1939, pp. 390–393. Operation of new sewage disposal plant, with capacity over 16 mgd, of Yakima, Wash., treating mostly waste from food canning and packing plants; clarification and digestion; pumping raw sludge; digester loadings.

REFUSE INCINERATORS, TENAFLY, N.J. Tenafly Refuse Incinerator Flash-Dries and Burns Sludge, A. R. Smith. *Mun. Sanitation*, vol. 10, no. 9, Sept. 1939, pp. 441–444. Excerpt from paper before American Society Mechanical Engineers describing flash drying of sludge with refuse incinerator heat and ultimate incineration of dried sludge in same unit; flow diagram at Tenafly, N.J., plant; psychrometric drying.

SEWAGE BACTERIOLOGY. Growth Promoting Substances in Sewage and Sludge—III, W. Rudolfs and B. Heinemann. *Sewage Works J.*, vol. 11, no. 4, July 1939, pp. 587–594. Experimental study of growth-promoting effects of vitamin C, carotene, amino acids, fatty acids, and naphthyl compounds. Bibliography.

SLUDGE. Sludge Collection and Skimming. *Mun. Sanitation*, vol. 10, no. 9, Sept. 1939, pp. 457–458. Practical discussion by superintendents of sewage disposal works of frequency and duration of operation of sludge-collection mechanisms in plain settling tanks; pumping sludge to digestion tanks; tank skimmings; solids content of sludge pumped to digesters.

SLUDGE. Sludge Dewatering by Freezing, J. R. Downes. *Water Works & Sewerage*, vol. 86, no. 7, July 1939, p. 282. Outline of method of sewage sludge dewatering by freezing, based on observation that there is ample power in gas from any digestion system, digesting domestic sludge, to freeze and thaw all of sludge digested in such system; drying and incineration of dewatered sludge.

SLUDGE. Sludge Filtration, L. W. Van Kleeck. *Water Works & Sewerage*, vol. 86, no. 7, July 1939, pp. 277–281. Dry solids in sludge; sludge concentration tanks; sludge freshness; industrial wastes in sludge; conditioning and mixing tanks; dry solids yield of vacuum filters; disposal of filter cake; incineration; bacteria in filter cake; use of sludge cake as fertilizer. (Continuation of serial.)

SLUDGE. Upside-Down Sedimentation Clarifies Centrifuge Effluent. *Eng. News-Rec.*, vol. 123, no. 11, Sept. 14, 1939, pp. 83–84. Novel method of clarification involving flotation of sludge, developed as adjunct to centrifugal sludge dewatering process, to produce final effluent containing less than $^1/_2$ per cent of solids.

STRUCTURAL ENGINEERING

ARCHES, THICK. Influence Lines for Thrust and Bending Moments in Fixed Arch, B. Eriksen. *Concrete & Constr. Eng.*, vol. 34, nos. 7 and 8, July 1939, pp. 378–392 and Aug., pp. 433–442. Theoretical mathematical discussion outlining original method of design of thick arches; horizontal thrust and its effect on arch; beam action; application of method; general data for design; graphical treatment.

BEAMS, CONCRETE. Construction Design Chart—XLIII, J. R. Griffith. *Western Construction News*, vol. 14, no. 7, July 1939, p. 248. Construction of alignment chart for computing shear in reinforced concrete beams; numerical examples.

BEAMS, STEEL. Simple Method of Designing Steel Beams According to Recommendations of

INDEX OF PRODUCTS

Continued on page 25

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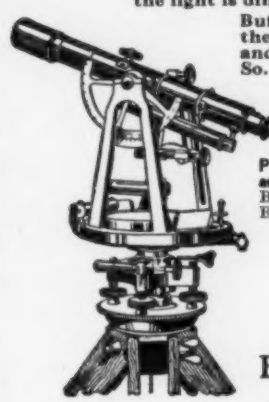

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Steel Structures Research Committee, S. D. Lash. *Structural Engr.*, vol. 17, no. 9, Sept. 1939, pp. 402–416. Outline of simplified method of design of steel beams in accordance with recent recommendations of British Steel Structure Research Committee; relation between depth and section modulus of standard beams; equivalent static moments for light beams; encasement factors; relation between encasement factor and static moment for beams encased in concrete.

DOMES, DESIGN. Ueber Schalen Gleicher Festigkeit, K. Federhofer. *Bauingenieur*, vol. 20, no. 27/28, July 14, 1939, pp. 366–370. Theoretical mathematical analysis of design of dome-like shells of revolution of uniform strength. Bibliography.

FRAMED STRUCTURES, STRESS ANALYSIS. Strength of Welded Steel Rigid Frame, A. H. Stang and M. Greenspan. *U.S. Bur. Standards—J. Research*, vol. 23, no. 1, July 1939 (RP1224), pp. 145–150. Distribution of stress in knee of welded steel-rigid frame specimen having straight flanges was determined from strain measurements; maximum load also was determined. Bibliography.

GIRDERS, CONCRETE. Der freiaufliegende wandartige Traeger im Stadium II, H. Bay. *Bauingenieur*, vol. 20, no. 27/28, July 14, 1939, pp. 375–379. Theoretical mathematical analysis of stresses in deep simply supported reinforced concrete girders after first appearance of cracks in concrete.

ROOFS, WIND PRESSURE. Druckverteilung an Giebel- und Walmdaechern, H. Mueller. *Bauingenieur*, vol. 20. no. 25/26, June 30, 1939, pp. 343–347. Results of experimental wind-tunnel study of distribution of wind pressure on gable and hip roofs; study of wind pressure on house models.

SLABS, STRESSES. Flexure of Rectangular Covering Slab Elastically Fixed by Its Four Sides, S. A. Savin. *J. Mathematics & Physics*, vol. 18, no. 3, July 1939, pp. 239–255. Theoretical mathematical discussion applying methods of mathematical theory of elasticity to particular case of flexure of homogeneous isotropic covering slab of rectangular form with its elastically fixed sides; formulas of normal tangential unit stresses; determination of support moments; form of deformed median plane of covering slab.

TUNNELS

SUBWAY STATIONS, LONDON. Reconstruction of Aldgate East Station. *Engineering*, vol. 148, nos. 3837 and 3839, July 28, 1939, pp. 97–101, and Aug. 11, pp. 159–162, supp. plates. Illustrated description of reconstruction begun in 1936 covering new station and alterations to tunnel east of it, as well as new bell mouth covered way between new and old stations.

VEHICULAR. Der Strassentunnel und seine Ausruestung, E. Neumann. *Bautechnik*, vol. 17, nos. 16 and 18, Apr. 14, 1939, pp. 225–228, and Apr. 28, pp. 257–260. Review of modern practice in design and construction of vehicular tunnels in Europe and America.

VEHICULAR, CONSTRUCTION. Cut-and-Cover Construction Method Used for 1,300-Ft Highway Tunnel. *Western Construction News*, vol. 14, no. 7, July 1939, pp. 236–238. Construction of 1,300-ft cut-and-cover tunnel which is to be part of Funston Avenue approach to Golden Gate Bridge in San Francisco; forms built for multiple-arch dam are adjusted and used in pouring concrete lining; design of tunnel providing for two 11-ft traffic lanes in each direction; concreting procedure.

WATER PIPE LINES

CORROSION. Bacteria, Corrosion and Red Water, T. E. Larson. *Am. Water Works Assn.—J.*, vol. 31, no. 7, July 1939, pp. 1186–1196. Study of effect of water treatment, as practiced at water plant of University of Illinois, on corrosion of pipes and formation of "red water"; changes in water composition as water is distributed from north to south ends of University of Illinois campus. Bibliography.

WATER RESOURCES

CALIFORNIA. South Coastal Basin Investigation. Records of Ground Water Levels at Wells for Year 1938. *Calif. Dept. Pub. Works—Dept. Water Resources—Bul. No. 39-G*, 1939, 115 pp. Tabulated data on water level records and rainfall records in Los Angeles-Riverside district of Southern California.

IDAHO. Geology and Water Resources of Mud Lake Region, Idaho, Including Island Park Area, H. T. Stearns, L. L. Bryan, and L. Crandall. *U.S. Geol. Survey—Water-Supply Paper 818*, 1939, 122 pp., supp. map, 75 cents. Investigation for determination of source of water supplying Mud Lake, Idaho, and its safe yield for irrigation; geology and occurrence of ground water; surface water; water tables; ground-water discharge and recharge; inventory of water supply; utilization of water supplies; drainage by means of wells.

UNDERGROUND, ARKANSAS. Ground Water Resources, K. Engler and D. G. Carter. *Agric. Eng.*, vol. 20, no. 7, July 1939, pp. 253–254 and 266. Results of cooperative research studies of factors involved in water supply for rice irrigation conducted over period of 10 years by University of Arkansas college of agriculture; studies of water requirements, withdrawal, and ground-water conditions; fluctuation of ground-water level in typical well, Grand Prairie Region, Arkansas.

WATER TREATMENT

CARBONATION. Dust Filters for Flue Gas for Carbonating, M. Udwin. *Am. Water Works Assn.—J.*, vol. 31, no. 7, July 1939, pp. 1201–1214. Use of flue gases from boiler plant to supply necessary carbon dioxide for carbonation and reduction of alkalinity of Vaal River water at Rand Water Board's plant at Vereeniging, Transvaal; design and construction of gas scrubbers and vortex pipe dust separator for carbonation plant; operating results.

CHLORINATION. Determining Residual Ammonia in Presence of Chloramine, P. W. Frisk and A. J. Conrad. *Am. Water Works Assn.—J.*, vol. 31, no. 7, July 1939, pp. 1197–1200. Progress report on experimental study of ratios of chlorine and ammonia at various pH conditions.

COAGULATION. Some Features in Water Coagulation, H. P. Stockwell. *Am. Water Works Assn.—J.*, vol. 31, no. 8, Aug. 1939, pp. 1387–1399. Review of principles of coagulation treatment prior to rapid sand filtration of water; properties of principal coagulants; commercial use of sludge; relationship between pH and color; minimum alum dosage for floc formation for Ottawa raw water; conditioning of floc; adjustment of raw water pH with sulfuric acid; effect of carbon dioxide on alum dosage.

FLUORIDE REMOVAL. Production of Mottled Enamel Halted by Change in Common Water Supply, H. T. Dean and F. S. McKay. *Am. J. Pub. Health*, vol. 29, no. 6, June 1939, pp. 590–596; see also *Water Works Eng.*, vol. 92, no. 13, June 21, 1939, p. 802. Surveys made in three communities in Idaho, Arkansas, and South Dakota after change in water supply, showing normal calcification of permanent teeth of local children. Bibliography.

SWIMMING POOLS, SANITATION. American Swimming Pool Sanitation. *Engineer*, vol. 168, no. 4361, Aug. 11, 1939, pp. 150–153. Account of practice in Illinois where all swimming pools and bathing beaches within its borders are under supervision of State Department of Public Health; series of official minimum requirements for sanitary conditions has been prepared, supplemented by additional information and suggestions for effective compliance; notes on design and construction; bathing load; water supply; equipment and operation.

WATER WORKS ENGINEERING

GREAT BRITAIN. Newport Water Supply. *Water & Water Eng.*, vol. 41, no. 513, Aug. 1939, pp. 422–427. Description of new water works of Newport, England, including earth-fill dam about 100 ft high and 10-mgd filtration plant.

GREAT BRITAIN. Talybont Reservoir and Filtration Plant. *Engineer*, vol. 168, no. 4358, July 21, 1939, pp. 64–66 and 72. Dam has maximum height above original ground level of 97 ft and contains 520,000 cu yd of earth and 40,000 cu yd of puddle clay; it creates reservoir with area of 320 acres and capacity of 2,567 million gal; filtration plant designed for total ultimate capacity of 10 million gal per day; present capacity of plant 8 million gal per day.

HAMMOND, IND. Hammond Water Works, U.S.A. *Engineer*, vol. 168, no. 4362, Aug. 18, 1939, pp. 192–193 and 184. Illustrated description of reconstruction and modernization of system of Hammond, Ind.

MAINTENANCE AND REPAIR. Maintenance and Repair Methods, N. N. Wolpert. *Water Works Eng.*, vol. 92, no. 16, Aug. 2, 1939, pp. 977–981. Description of repair shop and maintenance methods followed by water works of Cincinnati, Ohio; pipe practices; charge for private fire line; crews for emergency work; road improvements; air compressor unit for water department; tool bins.

MANAGEMENT. Budget Planning for Municipally Owned Water Works, J. P. Schwada. *Am. Water Works Assn.—J.*, vol. 31, no. 8, Aug. 1939, pp. 1263–1270. Review of American practices in water-works budgeting; developing financial policy; diversion of water-works funds; long-term planning. Bibliography.

UNITED STATES. Inventory of Water Supply Facilities. *Eng. News-Rec.*, vol. 123, no. 13, Sept. 28, 1939, p. 60 and supp. plate. Tabulated statistical data by states, of inventory of water supply facilities in United States, 1939, compiled from data supplied by state sanitary engineers.

VALUATION. Valuation of Water Works Systems in Canada, J. C. Keith. *Am. Water Works Assn.—J.*, vol. 31, no. 8, Aug. 1939, pp. 1361–1378. Principles of valuation of water-works systems in Canada; Canadian legislation and court decisions with reference to valuation of water-works properties.

VALUATION. Water Works Valuation for Rate Making in U.S., J. P. Wentworth. *Am. Water Works Assn.—J.*, vol. 31, no. 8, Aug. 1939, pp. 1379–1386. Prudent investment as measure of rate-base; going value as element to be considered in valuation.

INDEX OF PRODUCTS

Continued from page 23

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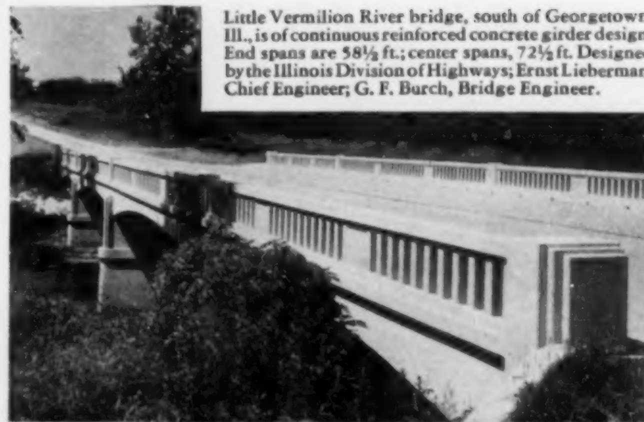

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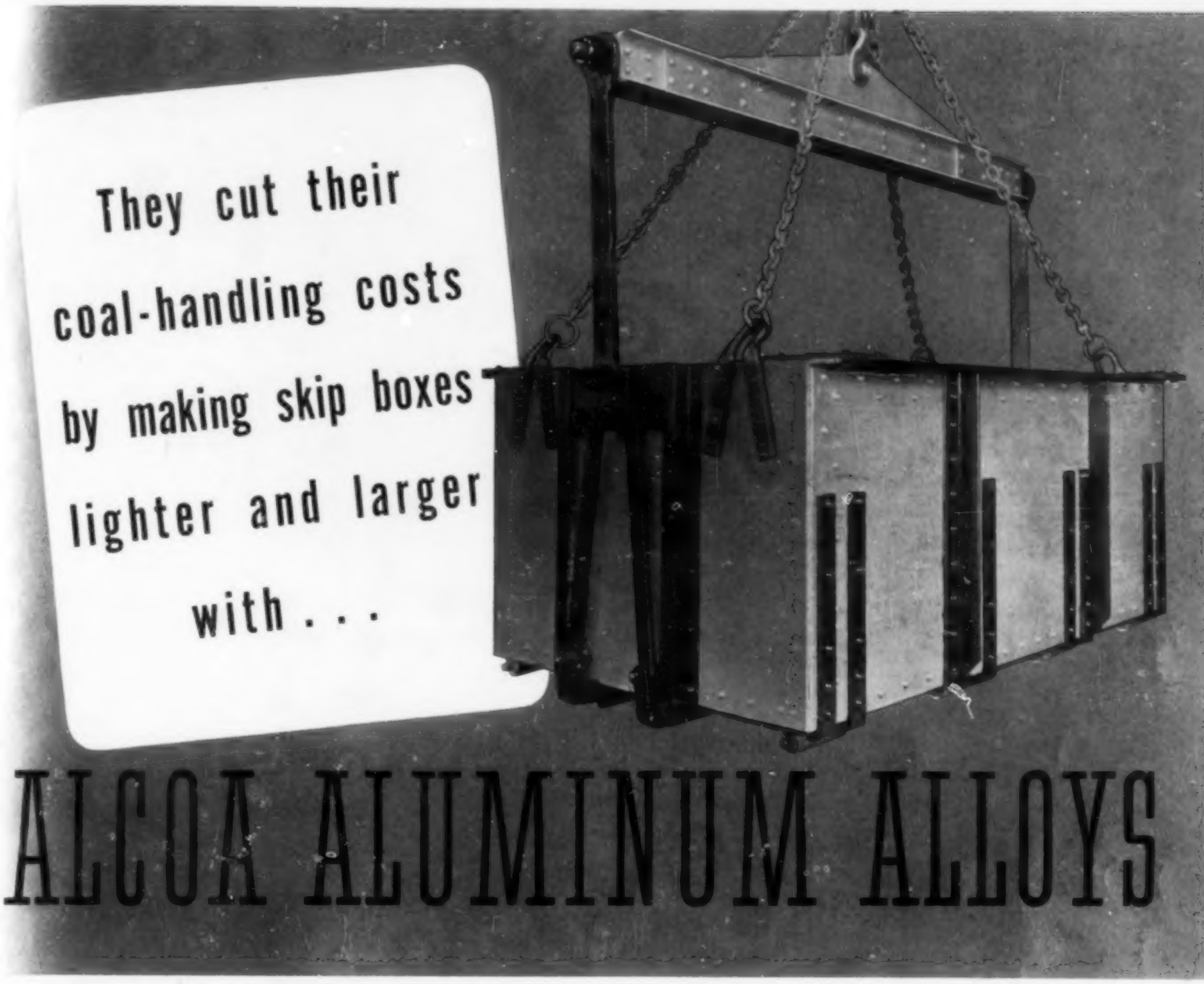
Index to Products Shown on Pages 23 and 25



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